ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LIV, No. 2. CHICAGO, SATURDAY, JANUARY 9, 1909. ISSUED WEEKLY

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY.

CHARLES W. PRICE, President.
H. S. TUTHILL, Secretary. PHILIP S. DODD, Manager.
C. W. FORBRICH, Assistant Treasurer.

PUBLICATION OFFICE: 204 DEARBORN STREET, CHICAGO.

EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.
EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C.
Henry W. Hall.

A. A. GRAY, Managing Editor.

The present publication comprises: ELECTRICAL REVIEW, VOL. LIV, No. 2; WESTERN ELECTRICIAN, Vol. XLIV, No. 2.

SUBSCRIPTIONS

One Year, United States $3.00
One Year, Canada 4.00
One Year, Foreign Countries 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each . .25

Changes of address reaching this office later than Monday cannot be made until the issue next following.

Application made for entry at the Post Office at Chicago as second-class matter under the Act of March 3, 1879.

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PROGRESS IN RADIO-TELEGRAPHY.

In the engineering supplement of the London *Times* for December 23, Mr. J. Erskine Murray presents a most interesting summary of present progress in radio-telegraphy. He calls particular attention to the substantial foundation for the mathematical theory of transmission of electric waves along the earth's surface, which has been laid by Dr. Zenneck. Many theorems of importance in practical telegraphy have been developed as a result. Thus the difference in ease of transmission over sea and land, respectively, has been accounted for, not only by difference in resistance, but also from the difference in their dielectric constants. The rate of absorption of the wave, and the consequent inclination of the lines of force to the earth's surface, can be approximately calculated when the wave-length and the materials of the soil and sub-soil are known.

Dr. Zenneck's theory indicates that in long-distance transmission the energy received has traveled through the upper region of the atmosphere. An interesting commentary on this theory is the still outstanding problem which has not been solved—that is, the fact observed by Fessenden that, though the absorption of a wave increases with its wave-length until it reaches about 2,500 metres, a further increase of wave-length causes a rapid decrease of the absorption, so that for a wave-length of 3,750 metres the absorption, even during the day, is very slight indeed. There appear to be two possible explanations: The first is that with very long waves the curve in which the energy travels may not stand so high as with shorter waves, and therefore may not enter the conductive upper layers of the atmosphere, thus avoiding absorption. The second is that the longer waves may actually resonate to some of the natural periods of the earth considered as a whole. If the second be true, there ought to be a rapid increase in the energy radiated by the transmitter as its wave-length is increased to the point of resonance. If the first be correct, no such rapid increase will be observed.

The work of Bellini and Tosi in developing a system of directive wireless telegraphy is commented upon as a most interesting application of theory to practice. It is known that the energy diagram of the radiation from a nearly closed aerial, forming an equilateral triangle, in a vertical plane, is approximately a horizontal figure 8—that is, a maximum radiation backward and forward, and zero in both lateral directions. The radiation in the forward loop is, however, in opposite phase to that in the backward. Thus, by adding a vertical aerial whose radiation is in phase with the forward radiation of the closed aerial, the latter is strengthened, while the backward radiation is annulled. The diagram is thus reduced to one loop, with

the sending station at the end of its longest axis. In practice two nearly closed aerials in the form of equilateral triangles in vertical planes at right angles to one another are used, in addition to the straight vertical aerial. Each has a helix at the centre of its base line, which serves as the secondary of a transformer, of which the primary is a third helix, movable about a vertical axis at right angles to its length. The axes of the secondary helices are fixed in the planes of the aerials to which they are respectively connected, and are thus at right angles to one another. Thus the action of the primary induces currents in them whose relative magnitudes vary with the direction in which the primary axis lies. The resultant radiation from the aerial system is thus the same as if one closed aerial used alone has been rotated into the line of the primary. No movement of the actual aerial conductors is necessary in order to alter the direction of radiation, and the great mechanical convenience of this arrangement is obvious. It is also possible to determine the direction from which radiation is arriving from a transmitting station, and the system should be of immense utility to stations where it is important that there should be no rearward radiation, as, for instance, in military operations.

COTTON MANUFACTURERS AND THE PRESERVATION OF WATERPOWERS.

The National Association of Cotton Manufacturers, founded in 1854, is one of the most progressive organizations of this country. Its function is mainly to increase technical knowledge and make available all possible information concerning the technical production of cotton manufactures, and to afford the members an opportunity for closer friendships and better understandings among those concerned with producing textiles.

Cotton manufacturers, situated as they are in localities which abound either in developed or potent waterpowers, are keenly interested in the subject of waterpower preservation, and the association is hard at work to influence opinion as to the ultimate necessity for strong action on the part of the United States Senate with regard to the proper conservation of waterpowers. Measures for the establishment of forest reservations at the headwaters of the streams among the White Mountains and upon the Appalachians have passed the United States Senate three times unanimously, with the exception of two dissenting votes on one occasion. The second of these bills received the unanimous approval of the House Committee on Agriculture at the time, but action on its report was not permitted on the floor of the House. This committee was afterwards reorganized, but the bill failed to receive the approval of a majority of the House Committee on Agriculture, after hearings last winter. This committee gave a hearing to parties interested, which occupied the whole of Wednesday, December 9. While it is not known what the decision of a majority of the committee will be, yet it is considered that all persons interested in this subject should be informed of the present status of the matter, and where their interest is involved, it should be their privilege and purpose to indicate to their congressman the necessity of proper consideration of these important measures.

STORAGE IN HYDROELECTRIC SYSTEMS.

The earnings of a hydroelectric system depend not so much on the maximum power that can be furnished as on the number of hours per year that same particular power can be used.

If a hydroelectric plant is designed to operate with more than the minimum flow of its river, as is true in most instances, the number of hours per year that any excess above the minimum power can be delivered depends in part on the storage area above the fall.

Many American rivers show wide variations between their maximum and minimum rates of discharge, and corresponding variations in the number of hours per year during which any particular rate of discharge is available. Thus the Connecticut River, at Holyoke, Mass., has a maximum discharge as high as 115,000 cubic feet per second and a minimum as low as 1,600 cubic feet per second, giving a ratio between maximum and minimum of about seventy-two to one. On the South Atlantic slope, the Yadkin River, at Salisbury, N. C., has a recorded maximum discharge of 130,000 cubic feet per second, and a minimum of only 900 cubic feet, giving a ratio for maximum to minimum of about 144 to 1.

With natural conditions like the above, the earning capacity of a hydroelectric plant depends in large measure on the storage area along the river that is created by its dam, as every cubic foot of available storage space represents just so much water that may be retained when the river discharge is too great, for use when the discharge would be otherwise too small to meet the demand for power.

On the other hand, at any particular power site, every increase of the storage area along the river means an increase in the height and cost of the dam, and in the area of land flooded, with a corresponding increase of costs, so that the value of a greater storage area has to be compared with the expense of creating it.

The cost of developing storage area behind a dam varies of course with the profile of the river, the character of its valley, and other factors, so that quite different results are practicable in various parts of the country.

In the South Atlantic states, the natural conditions are not, as a rule, very favorable to the development of large storage areas on the lower reaches of the main rivers, and the following data of several large hydroelectric plants serve as illustrations of the work in that section on these lines.

As the storage area obtainable in each instance, represented by the length of the reservoir along the river, depends on the head of water created by the dam, the length of the reservoir in each case is compared with the corresponding head.

One plant now under construction for a capacity of 24,000 electric horsepower is designed to have a storage reservoir along five-and-one-half miles of the river above the dam, and the head of water is seventy-six feet, so that each mile in length of the reservoir corresponds to about fourteen feet of head at the dam, on an average.

At another hydroelectric plant, where the intended capacity is also 24,000 horsepower, the dam that develops a head of

forty-eight feet sets back the water above to a distance of eight miles, thus giving one mile of storage along the river for each six feet of head created.

In a third case, a dam that develops a head of about thirty-seven feet holds a reservoir one-and-a-half miles long behind it, and here about twenty-four feet of head are required to maintain one mile of reservoir surface along the river.

Of course, where a dam creates most or all of the head for a hydroelectric plant, only a fraction of the water stored behind the dam is available for power production, because the head is reduced as the stored water is drawn off. The result is that it is usually practicable in such cases to reduce the depth of the stored water by only a moderate percentage of the working head, so that the available storage for power production is limited to a layer of water one or more feet deep over the reservoir surface.

30,000-VOLT GENERATORS.

A tendency to eliminate step-up transformers in long-distance power transmission has been manifest in late years since it has been found possible to insulate satisfactorily a generator for a potential suitable for direct transmission over a moderately long line. The maximum voltage yet attained in a commercial generator is 30,000 volts, which is the potential of the units installed in the hydroelectric plant at Manojlovac Falls, Dalmatia, as described in an article by Frank Koester in this issue. These generators are rated at 5,200 kilovolt-amperes at a power-factor of 0.8 and were designed and built by Ganz & Company of Budapest. They are likely to hold the record for high-voltage generation for a long time.

It is not exceptionally difficult to design a generator for 30,000 volts and possibly higher, but its use is attended with several undesirable features. The insulation of the conductors must be increased effectively, which means enlarged slots and diminished room for iron. On both the armature and rotating field the iron has to be worked at a higher saturation, increasing the iron losses materially. The factor of safety of the insulation is reduced and the machine is exposed to excess potentials, due to lightning or other line surges. This requires a better equipment for lightning protection. All these factors, together with others, increase the cost of the machine, decrease its efficiency and make it a more vulnerable part of the system.

On the other hand, with transformers, it is quite easy to insulate the coils to any possible line voltage, the generator operates at a higher factor of safety and gives better regulation, and the combined unit, generator and transformer, may give as good efficiency as the single machine and need not cost very much more. These features have caused American engineers to take the more conservative course of limiting generator voltages to, say, 15,000, and to prefer a comparatively inexpensive extra transformer to replace a burned-out unit instead of a reserve generator. However, it requires a careful balancing of the engineering and commercial advantages of each plan in each particular project to determine whether to use step-up transformers or to generate without them. Generator voltages have been steadily increased and it is not possible to predict what the limit in the future will be.

EXPORTS FOR NOVEMBER.

Exports of domestic merchandise, as indicated in advance sheets from the *Monthly Summary of Commerce and Finance*, issued by the Department of Commerce and Labor, Bureau of Statistics, for November, show a total value for the eleven months ending November, 1908, of $1,542,351,775. This compares with a total for the same period last year of $1,690,313,334. Exports for the month of November last amounted to $159,-965,581, as compared with a value for the same period last year of $202,459,395. In 1906 the exports for the eleven months ending with November were $1,584,618,061.

As far as the exports of domestic merchandise are concerned, then, the proportion is very good, and considerably better than the average of trade returns throughout the country would appear to indicate. Of this proportion, the exports of electrical apparatus, as closely as they can be segregated in the commerce reports, have a value, for the eleven months ending November, 1908, of $11,414,555. For the same period in 1907 the figure was $16,107,263, and in 1906, $15,191,909.

The exports of electrical apparatus in November, 1908, were valued at $759,503; for the same period last year, $1,242,-800. The decrease in total value of exports of domestic merchandise for the first eleven months of 1908, compared with the same period in 1907, amounted to eight per cent; the decrease in value of electrical exports for the same periods was twenty-nine per cent, while the decrease in value of electrical exports for November in 1908 compared with a year ago was thirty-nine per cent.

TRACTION AND TELPHONE BONDS.

The recent flotation of bonds to a large amount by traction and telephone companies has concentrated the attention of large investors on the stability of these young properties. Telephone companies have so far passed the experimental stage of their development that they should have little fear as to the stability of their earnings in the future. Aside from the fact that equipment has become more generally standardized, and thus more permanent than even a half dozen years ago, there is much less disposition on the part of public authorities to encourage competition. The bonds of lighting and power companies, and of street-railway corporations, occupy much the same position. With the splendid example of the earning power of properly regulated traction facilities, such as Chicago is blessed with—a recent report indicating that during the first twenty months of the management of the properties in connection with the Board of Supervising Engineers, the city's share of the profits amounted to over a million dollars—these securities are affording more attractive opportunities for investment today than ever before. Questions of franchise and permanency of street occupation are being settled in a saner manner, and the demonstrated ability of the companies to get on better with the riding public, the better acquainted the public becomes with the facilities, indicates that an even more prosperous era is to come.

OZONE PURIFICATION PLANTS.

BY S. H. HART.

Ozone purification plants are widely known on the continent of Europe, their theory and operation is fairly well understood, and a degree of mechanical efficiency has been attained there which makes them distinct competitors with other methods of purification of water for municipal supply. A recent report by New York city officials on the applicability of this method, while granting the superiority of ozone from a bactericidal and purification viewpoint, was somewhat adverse from the point of mechanical operation, and there have been practically no plants of this character in this country until quite recently. A few of minor size have been installed with a degree of mechanical efficiency as the result of a number of improvements and inventions which are apt to render them of much more importance in this field in this country than they have been in the past. Since the production of ozone is accomplished today in this process by the use of electric current of high voltage, the methods used in the plants in successful operation in this country, the current consumed, and the general efficiency of the plants as a whole, will undoubtedly prove of considerable interest to the average electrical engineer.

Almost without exception in the ozone purification plants existing on the continent of Europe, ozone is produced by the brush discharge from high-voltage static terminals over which a current of air is slowly drawn. This air, after becoming saturated with a certain amount of ozone, is then mixed very completely with the water. The resulting effect of the ozone upon bacteria and organic matter present in the water is extremely rapid, purifying the water in almost as short a space of time as is consumed in allowing the air to free itself from the water. In these plants, however, an air compressor is used for handling the air and commingling it with the water. Again, it has been found that the amount of ozone produced by the electrostatic process is dependent to a very great extent upon the hygrometric state of the atmosphere, and various types of refrigerating machines have been used to remove the moisture from the atmosphere before entrance into the ozonizers. Sometimes chemical dryers have been used, but in the most successful plants in operation in European cities today, a refrigerating system has been installed. The report by the New York city officials showed that fully twenty-five per cent of the power consumption was used in the production of ozone and that the other seventy-five per cent was used in the operation of the compressor and the refrigerating plant.

A recent improvement by J. Howard Bridge, whereby the air compressor has been eliminated, and the work of conveying the air throughout the water and of commingling it with the water has been accomplished by the water itself, has resulted in an increase in the mechanical efficiency of the process. Again, somewhat slight modifications in the ozone-producing apparatus have, to a certain extent, eliminated the deleterious effect of moisture, although only to a small amount. Tests have shown that the amount of ozone produced is dependent upon the amount of moisture present in the atmosphere, but the cooling of the air by the water, and the consequent deposition of a portion of the moisture by this process, has resulted in demonstrating the fact that the plant is more efficient mechanically without the use of a refrigerating machine, or chemical dryer, for the removal of the moisture when the costs of operation of this and the necessary attendance are considered.

The J. Howard Bridge process has been installed in a small municipal plant at Lindsay, Ontario, Canada, at costs of installation and operation which are surprising indeed, when the results obtained are considered. The water supply for this community was obtained from a lake and swamp that was surcharged with vegetable and animal matter at certain periods of the year, giving it a most unpalatable taste and furnishing rich pabulum for bacterial development. The use of wells had also proved undesirable, since the drainage system was not of the best, and typhoid fever was apt to be prevalent with the continued use of water from this source. The total cost of the purification plant, with a capacity of one-and-one-half million gallons of water per day, including the pre-filter, was in the neighborhood of only $7,000. The power consumed for the operation of the ozonizers was in the neighborhood of ten horsepower, and generally considerably less than this. This plant has practically broken all records for low cost of installation and economical operation when the amount of water purified is considered. The ozone purification plant occupies a small addition to the regular city pumping station, and the equipment takes up but a small space.

The ozone producers occupy a brick building only eight by ten feet, built against the pump-house. The air is handled by the water itself, which is allowed to flow into a deep well, from which it is pumped to the reservoir, after being freed from its ozone-carrying air. The action of the water in handling the air is similar in many respects to that in use in the Taylor hydraulic air compressor, which had its original installation at Magog, Quebec. In this the water is allowed to flow down one leg of an inverted siphon and up the other. Small intake tubes project into the water from the external air and impregnate the water with air drawn from the fine points at the immersed ends of the tubes. In this device the down-rushing stream of water carries innumerable bubbles of air, which are compressed as the pressure on the water increases. In a lower retention chamber the velocity of the water is diminished sufficiently to allow the air to rise to the surface. Although, indeed, fully twenty per cent of the air is lost in a majority of plants installed and in active operation in this country, an air-compression plant is obtained, having an operating efficiency of over seventy per cent, which is absolutely automatic in operation.

The ozone purification plant is in reality a combination of this system and the ordinary ozone-producer in common operation in European installations. The air is drawn through the ozonizers by means of aspirators, and, in turn, into the water in the down-flowing stream into the well. From this it is pumped rapidly into the reservoir. This is in reality the theory of the process, although in actual practice several modifications have occurred. Thus the water rushing into the well comprises an air compressor of the hydraulic type. The air under pressure is then forced through the ozonizers and through another set of aspirators, or injectors, which carry it into the water in an especially prepared concrete chamber for ozonization and complete commingling of the water with the air. A variety of modifications of this system, of course, can be employed. The one in question was installed on account of the increased efficiency of the ozonizers under these circumstances, in comparison with their operation where the air was drawn from the atmosphere directly into the water by the hydraulic air-compressor system. Again, the time in which the air

could stay in minute subdivision in the water was another influencing factor in the double modification.

The city current is brought into the building at 1,040 volts and is raised by step-up transformers to a little over 10,000 volts. Each of the two ozonizers in actual operation has its own transformer and independent air inlet and outlet, so that they may be operated together or separately. The two ozonizers consist of two separate iron boxes containing twenty-six separate units. Each unit has its own fuse, so that, if by any chance a short-circuit should occur, the unit affected would be the only one to go quietly out of commission, while the remainder would continue operating. These units are so constructed that a workman can remove or replace them in a few moments. The ozonizing unit itself consists of a series of large rectangular plates which are maintained at the required voltage. Over these the air is drawn through a series of small holes punched in the plate and having irregular edges to secure the action of the brush discharge.

The water undergoes preliminary filtration by passing through a small sandbox about twelve by fifteen feet, constructed of reinforced concrete, penetrating three feet of coarse sand to strain out the suspended matter. This filter is cleansed by simply reversing the current, the wash water coming from the city mains at a pressure of sixty to 100 pounds per square inch. In actual practice, the cleansing process occupies about three minutes and is done every day when the water is foul. At other times the filter may run several days without washing.

The number of arrangements by which this system can be operated and the particular one in use are of such a character in their effect on the resulting product that a complete resumé of the various arrangements possible and the one in actual use in this plant will undoubtedly prove of interest. The water can, if it does not require preliminary filtration, be allowed to flow directly down a well into a subterranean chamber and suck the air through the ozonizers into the water and commingle it with its fall by this process. If waterpower is at all available, the air pressure which results from the separation of the air in the lower chamber will be sufficient to raise the water to a certain height, or the water can be allowed to flow out at a lower level than that of entrance into the well. The air pressure from the subterranean chamber can then be re-diverted to the ozonizers, thus increasing their efficiency and producing a complete cycle, if desired. Again, if hydraulic power is available, in addition to a pump, which may or may not be a regular pumping unit, the air, without going through the ozonizers, may be drawn into the current and compressed in the subterranean air chamber. It can then be allowed to go through the ozonizers under pressure and be forced into the water at any point in its further progress and kept there as long as desired. In the particular plant in question the water passes entirely by gravity from the river through the filter and sterilizing well to the suction pipe of the pumps. From this the water is forced by pumps through the ozonizing chambers and down a series of four-inch pipes leading to the bottom of the well, thirty feet deep, passing the ends of a great many small brass tubes through which, by suction, the ozonized air is drawn and thoroughly mixed with the water. An arrangement of baffle plates prevents the too rapid escape of the ozonized air from the water. The two fluids, thoroughly mingled, flow, by way of the well, into the pure-water basin, at a slightly lower level, where the exhausted ozone separates from the water, which is then free to be pumped into the city mains and to the standpipe. The same pumps can thus be used for the alternate duty of pumping into the pure-water basin through the system and into the standpipe. As can be readily seen, a number of modifications of this type are possible. The water is clear and palatable and free from objectionable color, taste or smell. In addition to this, it is practically free from noxious germs, as the bacteriocidal properties of ozone have been abundantly demonstrated.

This development is of especial interest to small electric power plants, since it offers a new field for development and consumption of power in small units in many of the large cities in conjunction with the waterworks system. Practically no waterworks is too small to install such a plant, and, while the current consumption is small, it is, as a general thing, absolutely continuous and would naturally be obtained from the lighting service of the town in preference to the installation of an individual plant for this purpose. Its development in this country, however, is only in its inception, but the general use of ozone for a number of purifying purposes has received a tremendous impetus by virtue of this development and practical application.

Electrical Exports for November.

The electrical exports from the United States during November present, as is to be expected, a marked decrease compared with those of November, 1907.

The total electrical exports for November, 1908, were valued at $759,503, compared with $1,242,800 for November of the preceding year, 1907. Classified into appliances and machinery, the totals were: Electrical appliances—November, 1908, $463,588; November, 1907, $542,524. Electrical machinery—November, 1908, $295,915; November, 1907, $700,276.

The principal countries to which electrical products were exported during November, 1908, were:

Electrical appliances—British North America, $100,789; France, $89,013; Brazil, $53,832; United Kingdom, $47,625; Mexico, $31,819; Cuba, $30,361; Central America, $21,699; other South America, $19,442; Philippine Islands, $14,291; Japan, $11,043; Argentina, $9,501; British Australasia, $5,967; West Indies, $5,874; Germany, $4,872; Belgium, $4,737; British Africa, $2,945; other Europe, $2,157; other countries, $7,621.

Electrical machinery—British North America, $50,386; Japan, $47,467; Mexico, $42,950; other Europe, $42,328; United Kingdom, $35,276; Brazil, $17,087; France, $16,356; British East Indies, $14,201; Central American states, $7,092; other West Indies, $6,342; British Australasia, $5,669; Argentina, $3,588; other South America, $3,176; British Africa, $1,900; Cuba, $959; Germany, $619; Philippine Islands, $147.

The Electrical Committee of the Underwriters' Association.

The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held in New York city in March. The day and place of the meeting will be announced later. As usual, the provisions of the National Electrical Code, as they now exist, will be the principal matter for consideration, and it is requested that any desired changes in, or additions to, the Code, be forwarded to Secretary C. M. Goddard at 141 Milk Street, Boston, on or before February 1, in order that they may be printed in the bulletin, and the committee and other interested parties may thus have opportunity to consider them in advance of the meeting.

Dalmatian Carbide Works Using 30,000-Volt Generators.

By Frank Koester.

The manufacture of carbide has been carried on extensively for a number of years in certain sections of the Austro-Hungarian empire, particularly in the provinces of Dalmatia and Bosnia. In order to produce carbide on an economical scale the question of obtaining low-rate electric current was an essential one. In a section of Dalmatia this resulted in utilizing the Kerka River to such an extent that this undertaking is one of the foremost hydro-electric developments of Austro-Hungary.

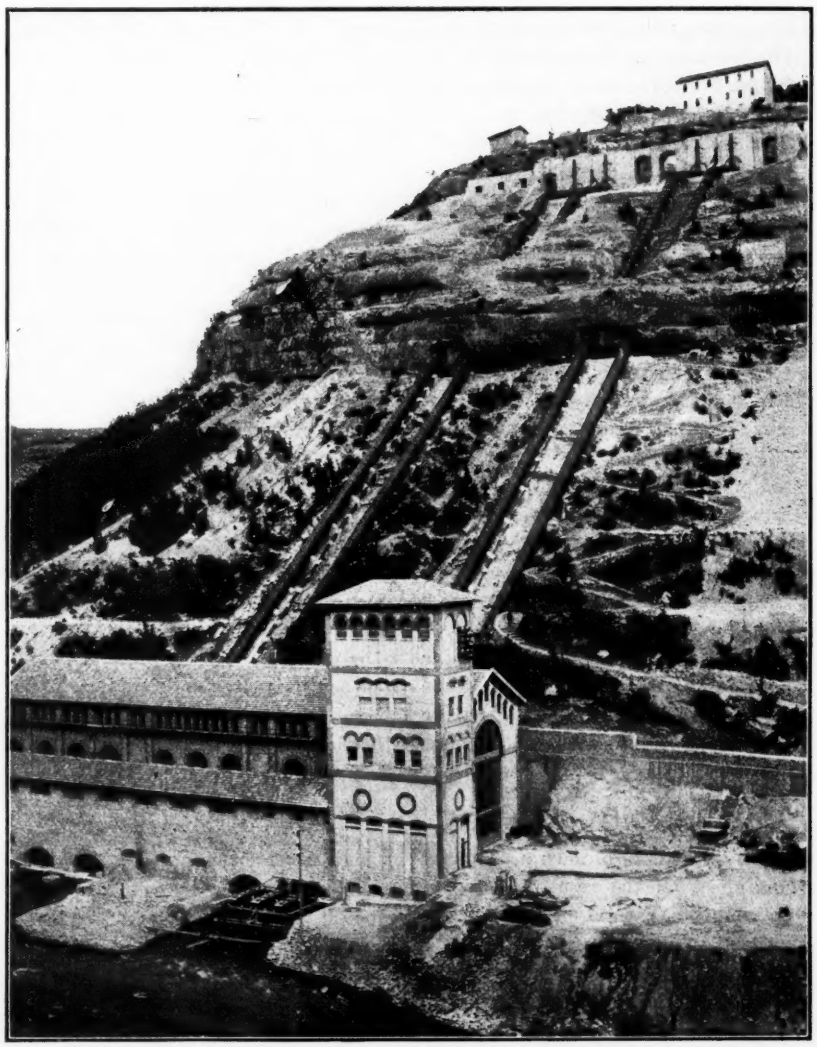
Of the many novel and unique features embodied in the hydraulic and electrical end the adoption of high-voltage generators, feeding directly a twenty-one-mile aerial transmission system at a potential of 30,000 volts and its simple, yet highly efficient, protective devices against atmospheric discharges, stand out most prominently. This is another continental step in the practicability and simplicity of generating current at high voltage for long transmission systems without the aid of step-up transformers.

The river Kerka rises at the foot of the Dinara Mountains, forming the boundary between Bosnia and Dalmatia, and flows southwesterly, emptying into the Adriatic Sea in the Bay of Sebenico, below the town of Scardona. The Kerka, although comparatively short, has throughout its length many scenic falls, varying in height from twenty-five to 147 feet, the latter named after the river Kerka and due to their grandeur being well known to Dalmatian travelers.

The first hydro-electric plant on this river, and today still in operation, was installed at the Kerka Falls in 1894; a 300-horsepower Girad turbine operating under a head of thirty-three feet is bevel-geared to a 220-volt, forty-two-cycle, single-phase generator. The current is stepped up to 3,000 volts and transmitted a distance of six miles to Sebenico for light and power. With the commercial success of carbide manufacture by electric current in 1898 a second 300-horsepower unit was added for experimental purposes in connection with two carbide furnaces.

The present owners of the water rights, "Societa per la utilizzazione delle forze idrauliche deela Dalmazia," of Trieste, started up a new plant at Jaruga, in 1903, with two 3,500-horsepower double Francis turbines, operating under a head of eighty feet. They are directly connected to 3,000-kilovolt-ampere, forty-two-cycle, two-phase alternators, making 315 revolutions per minute. The 15,000-volt generator potential is directly transmitted over nine-millimetre conductors to the carbide works some six miles away, not far from the town of Sebenico, where the pressure is stepped down to forty-eight volts by oil-cooled, water-circulated, single-phase transformers. The step-down station adjoins the carbide furnaces, so that the transmission line for 15,000 amperes is a very short one.

The current from this plant is consumed in eight carbide furnaces, requiring on the average 5,000 horsepower throughout the year. With the increased demand for carbide the factory has been recently extended to accommodate thirty-two furnaces, consuming on the average 32,000 horsepower throughout the year. For this purpose a new hydro-electric plant of 24,000 horsepower capacity has been installed at Manojlovac Falls, near Kistanje, some twenty-one miles upstream above the Sebenico carbide works. This plant, together with the above-mentioned earlier plants, was designed and installed by Ganz and Company of Budapest, who also supplied all the hydraulic, mechanical and electrical equipments of all these plants.



EXTERIOR VIEW OF MANOJLOVAC PLANT, DALMATIA.

Near the Manojlovac Falls the river

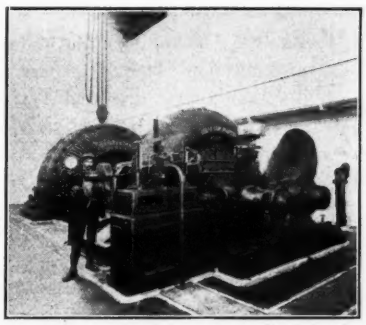
forms an S, and in the course of 1.2 miles has a drop of 360 feet. The flow varies greatly; in spring, due to snow thaws, it amounts to 1,700 cubic feet per second, and in exceptionally dry summer seasons to but 350 cubic feet per second.

MANOJLOVAC PLANT.

Just above the S referred to, the river forms a natural lake, with an outlet over a natural dam, which is tapped 6.5 feet below the crest, where the inlet to the head race is provided with three sluice gates. It will be seen that it was unnecessary to build a dam, yet sufficient water is impounded for dry season. The head race is 5,250 feet long, and has a slope of two feet in 1,000. It has a cross-sectional area of 117 square feet, cut through the solid rock of the mountain. To reduce skin friction, it is cement lined up to the water level.

In order to save excavation, two separate collecting basins joining each other have been installed. There are four penstocks and two penstock beds, due to the arrangement of the turbines in the generating room (a right and left hand turbine facing one another).

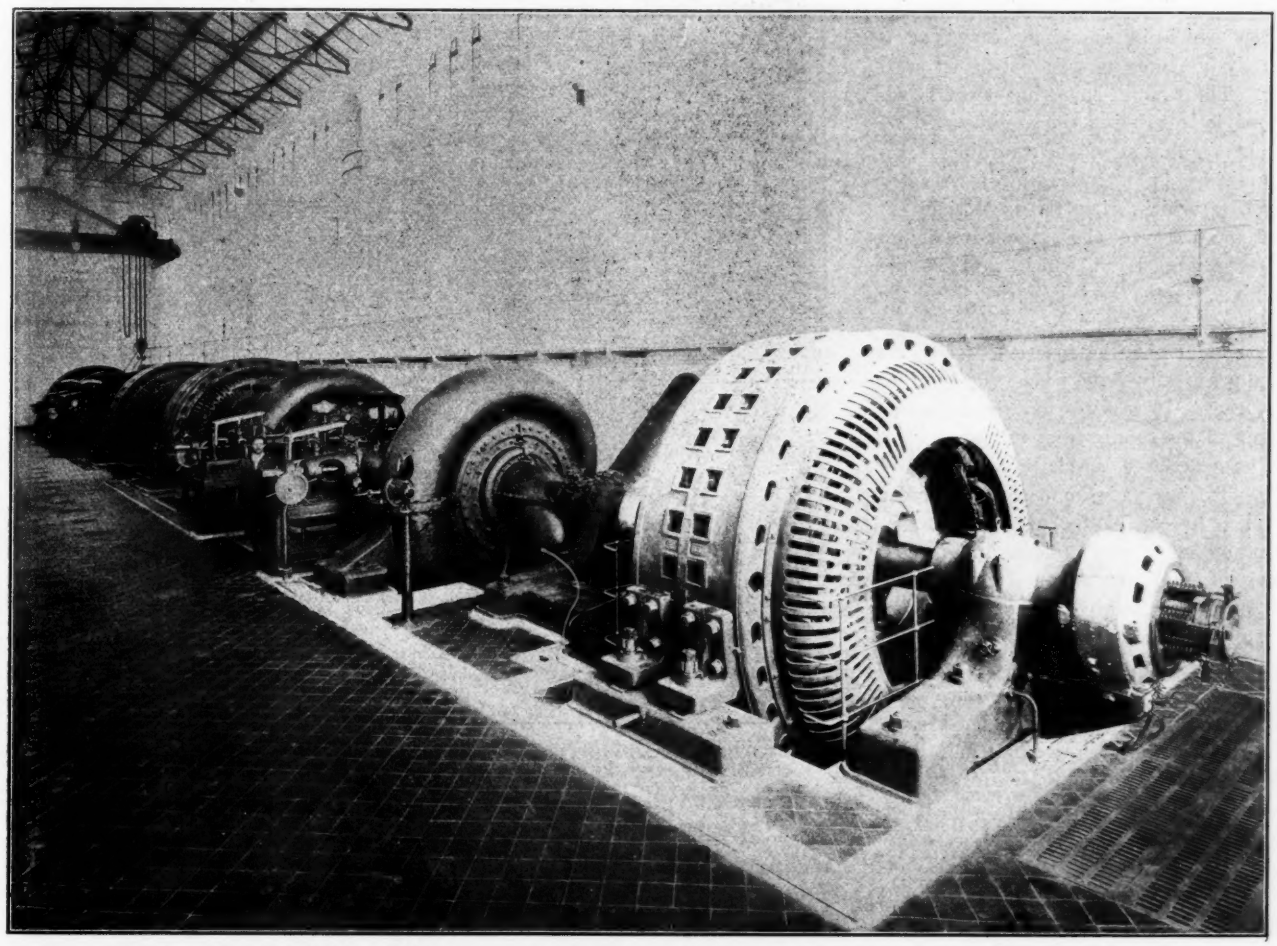
At the junction of the head race and collecting basin are fine screens. Each inlet to the penstocks is provided with a vertical-swinging sector gate, which is hydraulically operated. The pressure is supplied by gravity from a reservoir situated on the mountain slope about 165 feet above the collecting basin; the water for the reservoir is supplied by a small piston pump in the power house driven by a Pelton wheel under a head of 328 feet. By this arrangement the piston pump has to supply water against a head of about 300 feet. Should the supply water fail, provision is made to operate the sector gates manually by worms and gears.



6,000-HORSEPOWER UNIT, MANOJLOVAC PLANT, DALMATIA.

Adjoining the collecting basin is a filtering system of three gravel filters to supply the hydraulic governors of the turbines; the water is conveyed to them by means of cast-iron bell and spigot pipes. The water for the filter system is supplied by a small channel, branching off from the main head race. Thus the filtering is done by gravity, instead of under pressure, as is done in many European power plants where the connections to the filters are made at the foot of the main penstocks. Of course, with the latter arrangement, a different kind of filtering system is adopted.

The penstocks leave the collecting basin by bell-mouthed connections. Just outside of the wall are vents, so that, should the sector gates close before the turbines are cut off, the penstocks will not col-



INTERIOR OF MANOJLOVAC PLANT, DALMATIA, SHOWING 6,000-HORSEPOWER UNITS.

lapse. Each penstock is 558 feet long and sixty-three inches in diameter, having a shell thickness at the top of one-fourth inch and at the lower end of nine-sixteenths inch. They are shipped in sections 19.7 feet long, and contrary to the usual practice of bolting them by means of flanges, the sections are riveted together. The penstocks rest on concrete piers; the lower ends are well anchored, while the upper ends are provided with expansion joints.

GENERATING ROOM.

The turbines are of the Francis spiral type provided with two draft tubes. They operate under a head of 328 feet and with a water consumption of 212 cubic feet per second develop, at 420 revolutions per minute, 6,000 horsepower each. Owing to the size of the units, the double flow was adopted to obviate the side thrust which in the single-flow type is usually overcome by a special thrust bearing. The counter-balancing effect is adjusted by regulating the guide vanes.

The regulation of each turbine is accomplished by a hydraulically actuated governor, which, when the revolutions exceed ten per cent above the normal, operates a trip lever, which cuts off the supply. As the load is entirely for the manufacture of carbide, and therefore a very regular one, the governors come into play practically only when the turbines run away. It requires but three seconds to cut off the supply from full to no gate.

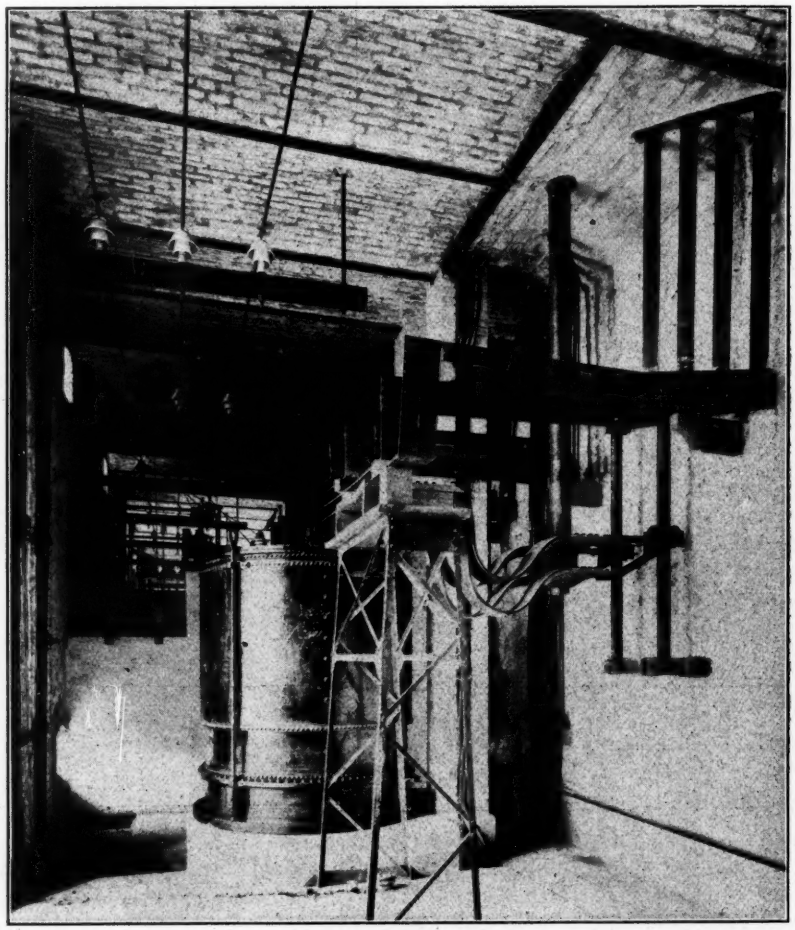
The generators, specially designed and built by Ganz and Company, are rigidly coupled to the shafts of the turbines. They are of a very unique design. In order to eliminate step-up transformers the generators, which are of the three-phase, forty-two-cycle type, are designed for 30,000 volts, and at 420 revolutions per minute, with a power-factor of 0.8, can deliver 5,200 kilovolt-amperes each. The efficiencies at full and half load with power-factor at 0.8, are ninety-four and ninety-one per cent, respectively. When running with a full load and a power-factor 0.8, at constant speed and excitation, a sudden dropping of the load will cause the voltage to rise eighteen per cent. With maximum excitation, the windings will stand a short-circuit for two minutes.

The revolving field consists of a cast-steel ring shrunk upon a spider wheel; twelve cast-steel pole cores are fitted into dove-tailed slots and secured by conical bolts. The field windings consist of flat copper strips, wound on edge, and held in place by the pole shoe, which is part of the pole itself. The insulation of the coils consists of paper sheets, and each is encased in a paper envelope formed to suit the coil. The whole revolving field with shaft weighs twenty-six long tons.

The armature frame consists of halves, which again are split perpendicular to the axis; these, when bolted together, form a perfect circular ring. It will be observed in the illustration that the feet for the frame are removable; this was provided for the following reason: The liability of a breakdown in a high-tension generator feeding directly into an overhead transmission line is greater, owing to atmospheric discharges, than one feeding an underground cable system, or that of a low-tension generator feeding transmission lines through step-up transformers.

In the pit the generator frame rests on two pairs of rollers, by means of which, after the feet have been removed, the whole frame can be revolved, and the lower section be brought on top and removed by the overhead crane, should it be necessary to inspect the coils in the lower half of the armature. By this arrangement it is not necessary to remove the revolving element of the generator.

The coils are machine form-wound in five different shapes. Each is composed of rectangular copper conductor. The convolutions are insulated by several layers of micanite, over which are wound several layers of insulating tape. Connections to the coils are made through brass terminals soldered to the ends of the winding.



1,500-KILOVOLT-AMPERE TRANSFORMER—27,000/48 VOLTS, 56/32,000 AMPERES, AT CARBIDE PLANT, SEBENICO, DALMATIA. THE INSULATORS FOR THE BUS-BARS ARE SIMILAR TO THOSE OF THE TRANSMISSION SYSTEM.

Each generator has its own exciter mounted on the overhang of the shaft. The most striking feature of this arrangement is the method by which the exciting current is led to the revolving field. On the extensions of the carbon brush holders are the copper brushes bearing on the collector rings (one of which is insulated), mounted on the shaft, adjoining the commutator. The generator shaft is bored up to the field; through this hole the exciter current is supplied by an insulated cable, the return is through the shaft it-

self, the whole being ingeniously arranged.

The generator bearings are 37.5 inches long and 10.625 inches in diameter; they are lined with white metal and are water-cooled.

SWITCH ROOM.

Parallel to the generating room in the middle and sunk in the opposite wall is the switchboard.

There are four generator panels, one collector or totalizing, and three outgoing panels. Upon each generator panel are mounted a rheostat for the exciter field; lever for the generator switch; a volt and ammeter, also voltmeter for excitation; phase lamps, synchroscope and double-throw switch for parallel operation.

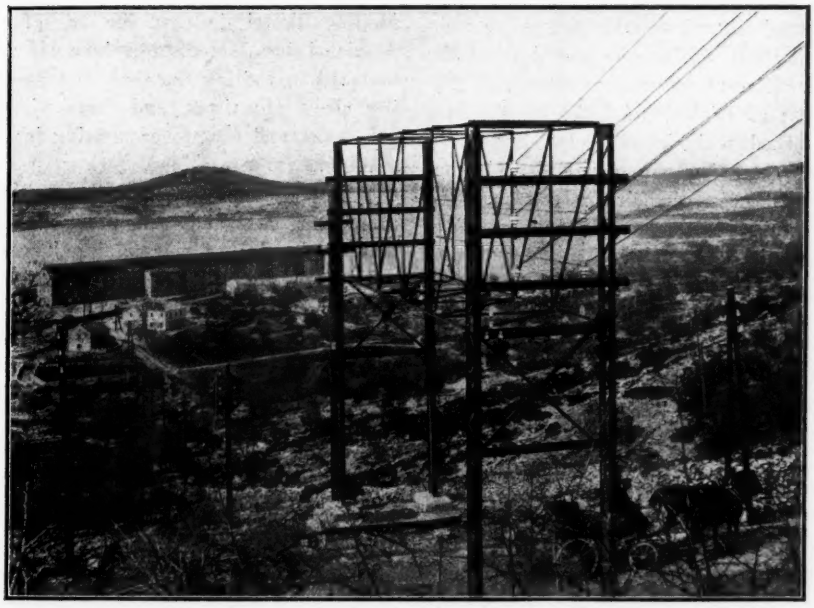
The totalizing panel contains three ammeters and a totalizing recording watt-meter. Further, there are three automatic switch devices, which open the field circuits of all exciters, in case of an excess of generator voltage or current overload, or a diminution of the generator pressure; and by means of the automatic turbine regulator the water supply to the turbines is cut off.

Each feeder panel has an ammeter and a pilot switch for the overload oil circuit-breaker.

Behind the switchboard is the switch room, the low building above the tail-race; the tower at one end is for the cut-going lines. All the switches and measuring transformers for each machine are placed in concrete cells; wherever possible the apparatus for each phase is in a separate cell.

The generator switches are of the single-pole, oil type, actuated from the switchboard by means of cable and sheaves. The moving element of each phase of a switch is connected to a common operating shaft. Adjacent to the oil switch cells are those for the series and potential transformers, and so continue for the four generator units. On the roof of the cells are hook switches, also placed in cells. On top of these is a single set of bus-bars; the different phases are separated by low partitions.

At one end of the bus-bars, after the fourth unit connections, are three double cells containing the general station protecting devices, consisting, for each phase of the system, of a condenser submerged in oil, a horn gap provided with auxiliary gap and a multigap lightning arrester shunted by a resistance placed in oil. From here the buses branch out into two feeders per phase for the two aerial circuits.



LATTICED CONSTRUCTION CROSSING TELEGRAPH LINES AND HIGHWAY. CARBIDE PLANT IN BACKGROUND.

The phases of each circuit are provided with overload circuit-breakers, potential and series transformers, for the ammeters and relays, and hook switches.

From here the lines pass to the upper floor of the tower, and just before leaving the building each is provided with the following combination of lightning-protecting devices: A choke coil with capacity cylinder; a horn gap with auxiliary gap, by means of which the main gap can be adjusted to a lower breakdown setting than the usual one, the horn being shunted by graphite resistance rods; further, a multigap arrester with shunt resistance; and finally, the ground connection is made through continuous waterflow grounders, which lead off light static discharges. The conductors leave the building through porcelain bushings.

It will be noticed that the protecting equipment is simple yet very complete; this precaution had to be taken because the generators feed directly an aerial transmission line which leads through a section of country passing over plateaus, canyons and valleys, very frequently visited by violent thunderstorms and other atmospheric electrical disturbances.

TRANSMISSION SYSTEM.

Both circuits lead to the carbide factory near Sebenico, about twenty-one miles distant, and are carried practically the entire length on wooden poles spaced normally 108 feet apart; the lowest conductor is some nineteen to twenty-three feet above the ground.

The conductors are nine-millimetre copper wire, carried on three-piece double petticoat porcelain insulators, the head diameter being seven inches and the total height 8.5 inches. The pin and first petticoat are held together by a glaze containing lead and glycerine. The head or second petticoat rests on the first with an air space between, formed by the ribs on the inside of the head. The insulators were tested at 80,000 volts, and during operation none has broken down.

Where the transmission line crosses small country roads the poles are placed on either side of the road, where they are also provided with grounded guard arms, so that in case of breakage the line is grounded; as the spacing is so close, a broken conductor cannot touch the ground. To take up side stresses on turns, the circuits are carried on A-frames. To protect the wooden poles against lightning, each has a pointed cast-iron cap with a ground wire.

An accompanying view shows a latticed construction used in crossing the principal highways and telegraph lines. The bottoms and sides of this steel construction are provided with a wire netting.

The transmission lines enter the carbide plant with a similar lightning-protection equipment as in leaving the power house tower, with the exception of the water-flow grounders, owing to the lack of fresh water.

After passing the lightning arresters connections of the two circuits are made to a common bus-bar system by automatic

oil circuit-breakers, and series transformers with their recording instruments.

There are installed twelve single-phase, oil-cooled, water-circulated transformers of 1,500 kilovolt-amperes each, stepping down the line voltage, which is here 27,000, to forty-eight volts, used in the carbide furnaces. Each transformer feeds two furnaces. The wiring system is so arranged, that from the control panel at each furnace, the transformer feeding it can be thrown on to any phase in order to balance the load of the circuit. Again, the division of load between the two furnaces of one transformer is indicated on a differential meter expressing the division of load in per cent.

There are further two 150-kilovolt-ampere, 27,000/330-volt three-phase transformers to operate auxiliary apparatus, such as, pumps supplying salt water for cooling the transformers; crushers and conveyors for limestone, coal and carbide; repair shops, and for driving the ventilators of the furnaces, etc.

The Manojlovac plant has been continuously in operation since the earlier part of 1907, and has given entire satisfaction. No trouble has been experienced with the transmission line, or the high-tension generators, although the country was frequented by heavy storms and lightning discharges.

Northwest Electric Light and Power Association.

After two days of technical and business discussion, the semi-annual convention of the Northwest Electric Light and Power Association closed with the re-election of its officers for another term. The principal subject of the sessions was the formulation of plans to meet prospective legislation. During the convention the members were the guests of the Portland Railway, Light and Power Company on several trips over the scenic lines of the company.

The re-elected list of officers is as follows: President, Arthur Gunn, Wenatchee, Wash.; first vice-president, A. Welch, Portland, Ore.; second vice-president, Francis Rotch, Fairbanks, Alaska; third vice-president, Henry Adams, Lewiston, Idaho; secretary and treasurer, Norwood W. Brockett, Cataract Building, Seattle, Wash.

The Northwest Electric Light and Power Association was formed at Seattle, Wash., on September 19, 1908, when about seventy-five representatives of electric-light and power companies in Washington, Oregon, Idaho and Alaska came together at a formal banquet.

Increase in Copper Production in 1908.

To the copper industry of the United States, the year 1908 was a period of gradual recovery from the severe depression suffered in the last part of 1907. Many producers that had greatly curtailed or even suspended production in that year began again to increase output practically at the opening of 1908, and, in spite of the low price of the metal, nearly all the important producers of 1907 were in operation throughout most of 1908, and a few new companies began production during the year. The rate of production has been steadily increasing, and is now greater than at any other time in the history of the industry.

The production of copper in 1908 has been ascertained by L. C. Graton, of the United States Geological Survey, through personal interviews and telegraphic communication, during the last days of the year. Except one small company, all producers of blister and Lake copper have furnished their latest exact figures, in most cases for eleven months, together with estimates of their production for the remainder of the year. If these estimates are realized, the production of blister and Lake copper in 1908 from ores mined in the United States will be greater by about 50,000,000 pounds, or between five and six per cent, than that in 1907, which was 868,996,491 pounds. It is wholly impossible at this time to publish figures of state production that are reliable, but it may be stated, concerning the three great copper-producing states, that Arizona and Montana show large gains, and Michigan shows little change from 1907. Production of total refined new copper by works in this country cannot yet be given, but probably it will hardly equal the output of 1907, which was 1,032,516,247 pounds.

Based on records of the Bureau of Statistics covering the first eleven months, the 1908 imports of copper in pigs, bars, etc., are estimated at about 160,000,000 pounds and in ore and matte at about 53,000,000 pounds. With addition for copper in pyrite, not included above, the total imports may be estimated as equivalent to about 210,000,000 pounds refined copper, a decrease of about thirteen per cent from 238,031,320 pounds in 1907. On a similar basis, the exports of metallic copper are estimated at about 660,000,000 pounds, the largest ever recorded, and an increase of about thirty per cent over the 508,929,401 pounds exported in 1907.

Stocks of refined copper are still undoubtedly very large. Domestic consumption of new copper will show a decline from the 485,000,000 pounds of 1907. The average quoted price of electrolytic copper at New York for 1908 was 13.20 cents. The price at the close of the year was 14.18 cents.

The prospect is bright at the present for a still larger copper production in the year 1909, but it is evident that the principal producers will, more than in recent years, gauge their operations by the consumption of the metal, which cannot at this time be safely forecasted.

Reunion of Thomson-Houston Employes.

The reunion of the old employes of the Thomson-Houston Company, previous to its absorption by the General Electric Company, will take place in Chicago during the Electrical Show, the date of the reunion being January 28. The day will be spent in visiting the show and gossiping about old times, and there will be a banquet and experience meeting in the evening.

This reunion is sure to call out many prominent men and will prove a very enjoyable and profitable affair. The reunion is in charge of the following committee: George Cutter, South Bend, Ind., chairman; H. L. Monroe, Monadnock Block, Chicago; P. H. Korst, Janesville, Wis.; Geo. P. Nichols, Old Colony Building, Chicago; I. E. Price, Canton, Ill.

All old T.-H. men intending to visit Chicago at this time and attend this reunion will please notify a member of the committee.

Public Service Commission Rules Against Special Rates.

By an order of the New York Public Service Commission which went into effect on January 1, all electric-light and power companies in New York city are forbidden to make special rates for electric light, power or heat which may be regarded as preferential or discriminatory. In addition the companies will be compelled to file with the commission and to post in their offices every tariff schedule of rates to be charged by such companies at least thirty days before such rates are to take effect.

These orders are the outcome of the commission's investigation which has been going on for nearly a year under Commissioner Milo R. Maltbie, who has held numerous hearings and had before him representatives of practically all the companies in the city.

THE ECONOMICAL DEVELOPMENT OF TOLL TERRITORY.

BY FRANK F. FOWLE.

The purpose of this paper, as the title suggests, is a consideration of the principal factors in building up and developing a toll plant on a dividend-paying basis. There are naturally two divisions of the subject, namely, the projection of an entirely new plant in undeveloped territory, and the development of a plant already in existence; but the latter division of the subject grows out of the first one, and undeveloped territory will be assumed as the starting point. Were there no previous experience in the toll business to furnish guidance in laying out a new plant in undeveloped territory, it would be necessary to proceed with the utmost caution. But it is now possible to predetermine, from previous experience, the volume of business to be expected under any given set of conditions, with a degree of accuracy that reduces the financial risk to a parity with that in any other business of furnishing public service.

It is found that the public demand for toll service occurs in such ways that certain laws may be formulated which will express mathematically or graphically the volume of message traffic which will occur on the average under any given or known set of conditions. The design of a toll system divides itself naturally therefore into two parts, first, the predetermination of the traffic, and second, the layout of a plant which will provide the necessary facilities in the most economical manner. Under the system of rates charged, or to be charged, it becomes apparent at once what portions of the proposed plant will be profitable at the outset, or, if the rates are not settled in advance, an estimate may be made of the plant charges and the operating costs to handle the traffic, as predetermined, upon which may be based a system of rates which will insure dividends from the outset.

After the plant is built and in operation, its proper development requires a perpetual observation and study of the traffic, both as to volume and speed of service, so that the rate of growth may become known and the need of additional facilities foreseen in sufficient time to provide them before the traffic congests sufficiently to materially impair the service.

TOLL-RATE SYSTEMS.

Early authorities on economics have defined the rate-making principle to be that of "charging all the traffic will bear," referring now to traffic in business of any sort, but when that definition was made there was no such thing as supplying public service on a large scale, competition was free and unrestricted, and monopolies, trusts and combinations in trade were unknown.

The supplying of public service has now come to be a vast industry, absorbing great amounts of capital and employing millions of persons, so that in a country as densely populated, as wealthy and as well developed as is ours today, the demand for public service of all kinds is stable and uniform. The risk to capital, therefore, in entering the business of furnishing public service of one or another sort is not an undue risk, and there is nothing inherently weak or faulty in this field from the standpoint of safe investment. While not among the absolute necessities of life, such utilities as gas, electric light, transportation and telephone and telegraph service, commonly classed as public services, have become nearly indispensable, if not wholly so, in our modern economic and social existence.

The public, partly through suspicion of public-service corporations, and partly through a belief in the common fairness and justice of their plan, have demanded that public-service rates be made upon the basis of "cost plus a fair return on the actual investment." In one sense this may be regarded as a new principle in rate making, but from the standpoint of the old theory this is the maximum rate which the traffic will bear, because there is no demand from a majority of the consumers at any higher rate; it is also the minimum rate which the traffic can bear, and at the same time exist profitably.

It becomes necessary to settle upon what constitutes the actual investment and also what constitutes a fair return on the investment. All legitimate expenses for securing franchises, rights and licenses are properly a part of the actual investment and as necessary as expenditures for the physical plant itself; this is also true of the expenses incurred in disposing of the company's securities, including discounts, commissioners, advertising and incidental expenses. The first cost of the physical plant is the major portion of the investment; added to it will be the first cost of plant enlargements, or extensions, as they are made from time to time, but no expense for reconstruction, which is chargeable to the current expense of conducting the business, because it is the outcome of depreciation and represents no increase in the plan or its earning capacity. In many discussions of what constitutes the actual investment no account is taken of those expenditures for the intangible property mentioned above, and it is held that the investment in physical plant constitutes the entire actual investment. This is manifestly unfair, as any unprejudiced consideration of the matter will lead one to see. It is unnecessary to go into the detail expenditures for plant, as they are universally classed in the actual investment. What constitutes a fair return on the investment is very likely a matter over which there are many honest differences of opinion at the present time, but it may be laid down as a sound proposition that no concern can be regarded as in good condition financially whose net earnings do not leave a fair surplus or margin after the payment of dividends, to meet unforeseen contingencies, and offset lean years. It is assumed, in making this statement, that operating expenses include not only the usual running expenses, but adequate allowances for maintaining the plant, taxes, insurance, legal expenses and an amount adequate to cover the annual depreciation, whether or not it has been actually spent in reconstruction. The dividend rates of railroad, industrial and public-service corporations average from five to seven per cent—sometimes lower and occasionally higher. Ten per cent is believed to be too high where there is little risk from any serious falling off of the public demand, and the company is practically insured against loss of business from the establishment of severe competition in rates or service.

It is a generally accepted principle that the investor is entitled to greater returns as he assumes greater risks; a return of six per cent is believed to be generally regarded as fair on a conservative investment and four or five per cent on an investment practically free of all risk. Total net earnings of eight to ten per cent on the legitimate, actual investment of a public-service company are believed to be fair and conservative; less than this can hardly be demanded without granting to the company special compensating advantages.

A public-service company which enters the field is obligated not only to supply the public demand at the outset, but to develop and expand as fast as the demand increases; any other course invites competition or gives an advantage to an existing competitor. Additional capital, therefore, will be required in the future from

time to time, and in order to obtain it on fair terms the company will have to show that it is in a prosperous condition, having paid dividends and amassed a sufficient surplus to insure that the margin between dividends and net earnings is not dangerously small. The rate-making basis which has been used in the subsequent consideration of the subject is cost plus a return of eight to ten per cent on the actual legitimate investment. Returns of five or six per cent are probably fair during the first year or two of operation; however, the returns should increase thereafter to the figures before stated. It is assumed that the plant has been laid out on a sound engineering basis, after a proper study of the territory has been made.

Turning now to the discussion of the rate-making principles which are peculiar to the telephone business, it may be observed that the telephone business is comparable with the railroad business, in the sense that both are transportation, the former of intelligence and the latter of goods and passengers. Transportation rates comprise two factors, the length of haul and the rate per mile; in thickly populated communities zones are established within which a flat price is charged for any haul. This is best exemplified in urban street-railway systems.

Precisely similar is the generally accepted rate basis for telephone service; in local-exchange service a zone is established within which any connection may be had for one and the same price, under measured service or flat rates, but between telephones situated not in the same zone, but in different zones, any distance from each other, a toll rate is charged, that is, a special charge for each connection. The two elements entering into a toll rate are the length of haul, or the distance between zone centers, and the length of conversation.

The mileage basis must prevail if each community is to enjoy fully all the natural benefits and advantages which accrue to it by reason of its geographical location with respect to other communities, and this basis is consistent with the principle of cost plus a fair return on the investment. The principle of graduating the rate in proportion to the length of conversation insures a distribution of charges in proportion to the amount of use; otherwise the charge must be based upon the average length of conversation, with the result that the user whose conversation is shorter than the average bears part of the burden which should rest on the user whose conversation is longer than the average; nor does this equalize itself in the long run, because all users do not make an equal amount of use of the service.

There should obviously be a uniform method of reckoning the mileages, and it is believed that air-line distances form the most equitable basis, except in the event of encountering some great natural barrier, such as impassable mountains or very large bodies of water, which necessitate special forms of construction or detouring the obstacles entirely, either result increasing the cost and warranting an increase in the rate. Highway mileages are not so satisfactory as air-line mileages for several reasons; low grades in highway building are always sought, so that distance may be voluntarily or even necessarily sacrificed to avoid excessive grades; moreover, highway distances are frequently affected by rivers and swamps, which necessitate detours. Railroad mileages are also objectionable, for the reasons just mentioned; pole lines can be built and maintained over routes where highways and railroads are impossible, therefore the air-line mileage basis, with the one exception previously noted, appears to be logical and equitable. It may rarely be possible to build a pole line along an air-line route, but the average increase of mileage caused by deviation therefrom will be small, unless a detour is purposely made, to touch some intermediate exchange or toll station. The air-line rate principle will promote the building of pole lines along the shortest, feasible routes, thus keeping the line investment at a minimum, insuring the lowest equitable rates, and therefore the maximum development.

The so-called "County Rate System" is a zone system, in which the political division of territory is taken as a rate zone. Quite commonly toll connections between all points in a county are established for one rate; where counties are thickly populated or of great area, the zone becomes too large, and a reduction in size is necessary. When a zone is so large that the difference between the theoretical mileage rate for the maximum haul and the similar rate for the minimum haul is considerable, both hauls being within the zone, a double injustice will result. First, the short-haul traffic within the zone must bear part of the burden which should rest on the long-haul traffic, because the same rate is charged for toll service between all points within the zone, regardless of the haul; second, a higher toll rate must be charged on traffic which originates in a given zone and terminates in an adjacent zone, because the average haul between them will be greater than in the case of two small zones which are adjacent. Between two towns situated only a short distance apart, one in a given zone and the other in an adjoining zone, the traffic must necessarily bear the toll rate which applies to all traffic between the zones, and consequently the equivalent mileage rate is very high, because the air-line distance is short. The result will be a suppression of traffic compared with the traffic that would result under an air-line rate. The remedy is smaller zones; the smallest practicable zone is a local-exchange district, but in very large cities it may be equitable to subdivide the city into several zones.

Passing to the consideration of the long-haul toll traffic, it will work out that all the zones in a small group or cluster will take substantially the same rate to a zone many miles distant, spanning a large number of intermediate zones; this principle may be stated in this form—as the length of haul increases, the rate zones may be enlarged. This may be recognized by creating major and minor zones, the latter being subdivisions of the former; short-haul rates would be established upon the basis of minor zones and long-haul rates upon the basis of major zones. For example, all the telephones in Cook County, Illinois, might take the same rate to St. Louis, but within Cook County there would be several minor zones between which the traffic would be subject to toll charges.

An analysis of the several elements of cost in establishing and maintaining a toll connection shows a very natural division of cost between lines and terminals, as regards both fixed charges and operating costs. These various elements may be assembled in a formula for determining the rate, as follows:

Let R = the total rate for a conversation of any length over any distance.

Let m = the rate per minute per mile, comprised of interest, depreciation, maintenance and taxes upon the lines and rentals for leased lines.

Let T = the maximum length of conversation permissible without charging for overtime, usually called the "initial period."

Let l = the length of haul.

Let P = the terminal-plant charges per connection, comprised of interest, depreciation, maintenance, taxes and insurance

upon the toll switchboards, equipment and buildings, the local-exchange trunks and the rentals for leased equipment, trunks and buildings.

Let L = the cost per connection of operating labor and traffic management.

Let G = the general expense per connection.

Let C = the commissions paid to toll agents or local companies, per connection.

Let t = the number of minutes of conversation in excess of the initial period, T.

The formula for the rate is:

$$R = m\,l\,(T + t) + P + L + G + C. \quad (1)$$

Minute-mile rates vary from one-tenth to two-tenths of a cent; the initial period is very commonly three minutes, but has been as high as five minutes and as low as one. The terminal-plant charges will vary greatly with the local conditions, but will never exceed a few cents per connection. The operating labor and traffic management costs will vary in offices of different sizes and with different operating systems; a fair range is probably from five to fifteen cents per connection. The general expense per connection should be the smallest individual item in the rate, in the neighborhood of two or three cents per connection. Commissions on originating toll business are usually made a percentage of the rate on each connection, from ten per cent to twenty-five per cent, but not to exceed a fixed amount, ranging from ten to fifteen cents.

The choice of the best initial period is a very important matter, because the volume of traffic received between two given points depends to a considerable extent upon the minimum rate. The average length of conversation will vary with different classes of traffic to some extent, and in order to develop the traffic from as many sources as possible, it is desirable to make the initial period short—considerably less than the average duration of conversation for all traffic. Five minutes is probably too long for the bulk of the traffic; an average of about four-and-one-half minutes has been observed where the initial period was three minutes. For short-haul traffic, which partakes somewhat of the nature of local-exchange traffic, the length of the initial period is not so important, because the rate is low in any event; but in long-haul traffic a short initial period undoubtedly develops more traffic than a long period.

Toll calls are commonly classified in two ways, according to whether the calls are made by number or for particular parties; the former is styled two-number business, and the latter, particular-party business. There is a very large degree of economy in circuit loads and operator loads from handling toll traffic on a two-number basis, rather than a particular-party basis; it is practically necessary to handle short-haul traffic on a two-number basis, and the zone within which traffic can be so handled is limited only by the permissible size of the directory, which must list all telephones in the zone, so that subscribers may call by number instead of by name. Under this plan the calls made and not completed will be limited to the cases where the number called is busy or does not answer.

For long-haul traffic the particular-party basis is practically necessary, because in a large majority of cases the person calling desires a particular person at the place called, rather than anyone who may answer the telephone, and because of the large amount of the rate charged, the patron does not care to incur the risk of not finding the desired party at or within reach of the telephone. On short-haul traffic some companies accept particular-party calls at an increase over the two-number rate, of twenty-five to fifty per cent; but no companies handle long-haul traffic except on the particular-party basis.

On traffic of the latter class there is commonly a considerable amount of lost business, comprised of incompleted calls, which will vary from five to thirty per cent of the total calls received, according to the character of the traffic and the time of year. The percentage of lost business is always high on traffic to summer resorts and places of amusement. If the traffic becomes congested for any reason, such as the holding of large conventions, fairs and exhibits, the sudden occurrence of public calamities, or the failure on the part of the telephone company to furnish facilities to keep pace with the natural growth of the traffic, there will be consequent delays to service and an increase in the percentage of lost business. It has been proposed to make a small charge for an incompleted call or lost call, on the theory that the toll lines have been used to pass the call and the report, and the time of several operators has been consumed to about the same extent as though the connection had been completed; such a charge would be composed of items P, L and G in formula (1). The result would be to make possible a slightly lower rate on the completed calls, but the burden of the cost of handling the lost business is otherwise distributed over the completed calls, which in number are several times the number of lost calls, and the burden therefore amounts to very little on each connection. The plan is entirely logical, but it has not been used to any extent, and is of doubtful popularity with the public.

There is some variation in the practices of toll-line companies as regards a reduction in the rates between certain hours of the day, usually from 6 p. m. to 6 a. m., when the traffic would be otherwise small. Some companies have never given a reduced night rate; others have given a half-rate, and some of these have abolished it recently. Night half-rates were originally given, it is believed, to stimulate traffic and educate the people to the use of toll service. This purpose was undoubtedly accomplished, but there was developed at the same time a considerable volume of night traffic which could not bear the full day rate. That is, the service at night half rates came within the means of and became useful to a large number of persons who could not afford the full day rates, or only a very limited use at those rates; this class naturally resented the abolition of the night half rates. A toll rate, graded according to the demands upon the toll lines at various hours of the day, has to recommend it the same reasons that make it good policy to grade the rates for local-exchange service according to whether a telephone is located in a place of business or a residence, according to whether it is connected to a single or a party line, and also, under measured service, according to the number of local messages. In other words, it is good policy toward the public to present a rate schedule which will develop the greatest number of patrons, distributing the burden of expense among them in proportion to the amount and the grade of service rendered to each patron; in no other way can a maximum development be reached or the public be served so completely.

There is one very essential point in connection with reduced night rates or rate reductions at any time of day, and that is a consideration of the factors in formula (1), which may properly be reduced; the minute-mile rate m, is the only factor which should be given different values during various hours of the day, although it may be remarked that any plan which increases the total number of connections should decrease the average

values of the factors P, L and G, and possibly C. Proceeding on the theory that a reduced night rate places the service within the means of another class of patrons, and consequently increases the night traffic, it is also reasonable to expect that some of the former patrons will, for reasons of economy, transfer their calls to the night period; it is reasonable, therefore, at the time of instituting a reduced night rate to raise the day rate slightly. Conversely, the discontinuance of a night-rate schedule should be accompanied by a slight reduction of the day rate, unless the change is intended to increase the gross revenue and decrease expenses.

A graduated rate, as will be shown later, is the one means which the telephone company possesses to regulate the public demand for connections; the graduated rate principle may be used to cut down the peak of the traffic load and build up the load at times when it would otherwise be small—that is, to secure a higher load factor. Periods of large and sudden demand cause slow and uneven service; any means for avoiding them produces better service, because the average delay is less and the delays are more uniform. In some instances the large number of appointment calls received for connection at the commencement of the low rate period of the day has resulted in traffic congestion and poor service.

There are several remedies, one of which is to cancel the night rates, but this is unnecessary, because the difficulty may be avoided by substituting a period of a few hours in which an intermediate rate schedule is in effect, so as to avoid sudden rate changes of considerable amount; the difficulty may be avoided also by refusing to receive appointment calls, but it would be a more logical plan to make an extra charge for appointment calls on account of the extra load placed upon the operators, and thereby reduce the number of such cells, they having been given free of extra charge in the first instance.

When toll traffic is handled over circuits whose ownership is divided between two or more companies, the revenue should be prorated between the companies. There are various methods of doing this, but in order that both companies may be done equal justice the method which is used should divide the revenue in proportion to the expenses and plant charges of each company.

Under this method of settling accounts between two companies the following procedure would be duplicated with the business between each pair of zones or toll centers; compute the average revenue per message and the average length of conversation from the total business for the month and then divide the average revenue per message into two parts.

Let R = average total revenue per message.

Let R' = the proportion of average total revenue going to company A.

Let R'' = the proportion of average total revenue going to company B.

Let l' = the line mileage owned by company A.

Let l'' = the line mileage owned by company B.

Let $T + t$ = the average length of conversation.

Let P'', L'', G'' and C'' = the terminal charges incurred by company A.

Let P'', L'', G'' and C'' = the terminal charges incurred by company B.

The relations are then expressed by:

$$R' = m\,l'\,(T+t) + P' + L' + G' + C'. \quad (2)$$

$$R'' = m\,l''(T + t) + P'' + L'' + G'' + C''. \quad (3)$$

$$R = R + R''. \quad (4)$$

The traffic is usually the same in each direction over the circuits in a period of a month, but if there is any material difference, separate settlements may be made upon the traffic originating at each end of the line. After the terminal charges are once settled upon they may be lumped into a single sum for ease in computation. Should the number of lost calls not be substantially the same on traffic originating at either end of the line, a special allowance may be agreed upon, comprised of a small amount to cover the cost of handling such calls, this allowance to be applied only to the excess of lost business in one direction over the lost business in the other, there being no allowance to either company when they lose an equal number of originating calls. If l' is greater than l'', company A loses more revenue than company B when the line is out of service for any reason; it is therefore to *A's* interest to have B clear all circuit trouble in *B's* territory very promptly. This may be accomplished by an agreement that when B fails to clear the line within a stated maximum period, A may send a lineman after the trouble at *B's* expense; of course this plan should operate both ways. Another plan may be worked out on the basis of penalizing the company which has failed to clear any troubles after a stated maximum interval.

[To be continued.]

Association of Edison Purchasing Agents.

The fifth regular meeting of the Association of Edison Purchasing Agents was held at Buffalo, N. Y., December 18. Included in the transaction of business was the election of officers for the ensuing year. The only change in the personnel of the officers was the election of C. A. Harding to succeed the late R. C. P. Holmes, of the Commonwealth Edison Company, Chicago, Ill.

The present officers are: President, H. F. Frasse, the Edison Electric Illuminating Company of Brooklyn, N. Y.; vice-presidents, C. A. Harding, Commonwealth Edison Company, Chicago, Ill., and H. C. Lucas, Philadelphia Electric Company, Philadelphia, Pa.; treasurer, James B. Eaton, Rochester Railway and Light Company, Rochester, N. Y.; stock controller, Andrew Banks, Consolidated Gas, Electric Light and Power Company, Baltimore, Md., and secretary, J. W. Brennan, Edison Illuminating Company, Detroit, Mich.

The next regular meeting of the association will be held at the same time and place as the convention of the National Electric Light Association.

More Time for the Illinois Tunnel Company.

The Chicago Council Committee on Gas, Oil and Electric Light voted on December 22 to recommend an ordinance giving the Illinois Tunnel Company two years in which to comply with its telephone ordinance. This means that the company will have until February 8, 1911, in which to install 20,000 telephones and thus save its franchise.

The company in return agrees to insert in its main tunnel-franchise ordinance a clause providing for publicity of all its accounts for the information of the city when the time comes for the Council to fix its carrying rates; also a provision that its present telephone system be kept to at least its existing condition, and not be allowed to depreciate during the coming two years.

The application of the company for the right to sell its telephone rights to the Chicago Telephone Company was not passed on. The committee decided that this was too important a matter to be decided hastily, and that with the extension of the time limit for the installation of the needed telephones, no immediate action was needed. It will, however, pass on the question as soon as practicable.

The Faraday Society.

The thirty-ninth ordinary meeting of the Faraday Society was held on December 15, 1908, at the Institution of Electrical Engineers, London, England. Dr. T. M. Lowry occupied the chair.

A paper by Dr. F. J. Brislee on "A Redetermination of the Electrolytic Potentials of Silver and Thallium" was read by Dr. Wilsmore. The electrolytic potentials of silver and thallium were redetermined over a range of concentrations and in solutions of two different salts—silver in silver nitrate and acetate solutions, thallium in thallous nitrate and chloride solutions. The general mean of both series of measurements for silver is: $+1.0757 \pm 0.0006$ volt. For thallium it was found to be: -0.0425 ± 0.0005 volt.

A paper entitled "The Heats of Combustion of Aluminium, Calcium and Magnesium" was read by Frank E. Weston and H. Russell Ellis. The authors conclude that the heat of combustion of magnesium is greater than that of calcium and calcium than that of aluminium. However, the heat of combustion of magnesium is not much greater than that of calcium. The partial reduction of CaO by aluminium and of MgO by calcium are probably endothermic reactions, similar to the reduction of B_2O_3 by potassium and sodium. The authors are of opinion that the reactions they described are complicated by the interaction of the hot metals with the air, and in order to throw light on this point experiments are being carried out in vacuo.

Dr. H. Borns said that the question of heats of formation could hardly be discussed until the results of experiments to be made in vacuo were known.

H. K. Picard was able to confirm most of the results obtained by the authors. He suggested the reaction between alumina and aluminium sulphate as an interesting one to study, as it might prove to be a source of aluminium.

H. R. Ellis adduced reasons for supposing that when magnesium was employed the nitride obtained was not, as had been suggested, magnesium nitride, but the nitride of the metal reduced.

Dr. N. T. M. Wilsmore thought the reactions were too complicated to allow of deductions from the heats of formation of simple oxides.

H. Russell Ellis then read a paper on "The Formation of Graphite by the Interaction of Magnesium Powder and Carbonates." He showed that magnesium powder readily attacks carbonates, producing, among other substances, a black powder. This black powder consists of amorphous carbon mixed with graphite, which latter substance always predominates. When magnesium is burnt in CO_2 a mixture of graphite and amorphous carbon is produced, more of the amorphous carbon being present. The graphite was identified by converting into graphitic acid by oxidation by means of a mixture of dry $KClO_3$ and fuming nitric acid. In some cases the graphite was estimated by boiling the mixture with fuming nitric acid until no more brown fumes were produced, evaporating to dryness on a water bath, dissolving out the humic acid, and weighing the graphite on a tarred filter-paper. The process is very slow, taking several days. In all cases when a carbonate was attacked by magnesium powder graphite was produced.

A preliminary communication on "Colloidal Barium Sulphate" was made by Dr. Ernest Feilmann. This was obtained by adding barium chloride solution to a solution of an equivalent amount of sodium sulphate which has been previously mixed with a sufficient amount of alkali-casein solution. It was a translucent, horny mass. When first prepared it was quite soluble in water. After keeping for some time it requires the addition of a little very dilute alkali for complete solution. As a result of the general behavior of the substance, its appearance under high powers of the microscope, and other considerations, the author has come to the conclusion that it consists, in all probability, of particles of barium sulphate surrounded by an enveloping layer of casein; therefore a casein surface only comes in contact with reagents, a fact which to a certain extent accounts for the "protective" action.

Dr. V. H. Veley suggested many further lines of investigation, such as the use of other colloidal menstrua, the determination of the size of the particles, the conditions of precipitation by acids, and resolution by alkalies, and so on. It appeared possible that every variety, from well-defined crystals to amorphous masses of barium sulphate, could be obtained.

Prof. W. W. Haldane Gee agreed with the author that here was a case of barium sulphate nuclei protected by an organic colloid, and thus producing stable colloidal solutions. The coating might form an electric "double layer," preventing neutralization of the nucleus by oppositely-charged ions. He suggested further extensions of the method.

Dr. G. Senter though examination of the particles by the ultra-microscope would prove instructive.

Dr. H. Borns suggested a possible application of these colloidal solutions in the production of uniform reflecting surfaces—for photometric purposes, for example.

Annual Meeting of the Western Society of Engineers.

The thirty-ninth annual meeting and dinner of the Western Society of Engineers was held in the banquet room of the Chicago Athletic Association on January 5. About 135 members and guests were present. Announcement was made of the newly elected officers to serve for the year 1909. These are: President, Andrews Allen; first vice-president, Peter Junkersfeld; second vice-president, O. P. Chamberlain; third vice-president, Prof. W. F. M. Goss; treasurer, Albert Reichmann; trustees: for three years, George M. Brill; for two years, W. C. Armstrong; for one year, L. E. Ritter; secretary and librarian, J. H. Warder.

After the dinner the first address was by the retiring president, C. F. Loweth, who referred to the newly enlarged quarters of the society in the Monadnock Block as the principal achievement of the year. The society was organized in 1869 and now has about 1,000 members. At the last meeting of the board of direction Octave Chanute had been elected an honorary member. Brief responses were made by Mr. Chanute and President-elect Allen.

The principal addresses were made by Frank Trumbull, president of the Colorado & Southern Railroad, who spoke on "The Railroad Situation of Today," and by General Grenville M. Dodge, on "The Civil and Mechanical Engineers' Work in the West in an Early Day and During the Civil War." Mr. Trumbull decried the agitation against the railroads, as it is caused principally by political bacteria. Government control, with financial responsibility, as exemplified in the Chicago traction settlement, may be a satisfactory solution. General Dodge spoke principally of the work of the engineer corps of the army during the war in building railroads, bridges and intrenchments, and of the pioneer work of the engineers who laid out the first transcontinental railroads across the mountainous and barren West, fighting Indians and disease and overcoming all kinds of hardships.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER II. (PART V.)—MOTORS.

In the case of alternating current as well as with direct current, the transformation of electrical into mechanical energy makes use of principles which are simply the reversed application of those applied in the electromagnetic generation of the current, although certain features are emphasized in either case that are not in general use in the other. For example, the induction motor is the type that is coming into general use, but the induction generator is not as common.

Among alternating-current motors there are the following classifications:

1. Synchronous type.
2. Induction type.
3. Single-phase series type.

SYNCHRONOUS MOTOR.

Just as two alternators can be run in parallel if brought into synchronism, it is evident that one alternator can drive another if the two are brought into step. One of the chief difficulties of running a single-phase synchronous motor is that this type of machine is not self-starting, but must be brought up to speed to be "in step" before it will operate. Polyphase synchronous motors, however, are self-starting without load, and for this reason are usually preferred. They are used only when large amounts of power are required continuously.

NECESSITY FOR EXACT SYNCHRONISM.

For stability of operation it is necessary that the motor should run in exact synchronism with the generator. Were it not for the fact that an alternator once started to operate as a motor automatically maintains this synchronism, this type of motor would be entirely impracticable.

When one of these motors is running without load, its counter-electromotive force is practically equal to the applied pressure, just as is true of a direct-current motor. In the latter case when the load is thrown onto the motor, it slows down in speed somewhat, the counter-electromotive force becomes less than the pressure applied, and the considerable current which flows through the armature, has its energy transformed into mechanical work. If the synchronous motor fell behind in speed as the load was thrown on, it would get out of step and finally stop. As a matter of fact, however, it maintains its speed nearly constant, but falls back in phase with respect to the applied electromotive force, so that a current sufficient to operate the load passes through its armature. Because of this change of phase and the resultant change of current through the armature, the motor practically adjusts itself to varying load conditions independently of excitation, which can therefore be maintained at a constant value. It is even possible to operate the motor when the excitation is considerably greater or less than the normal value.

FIG. 62.—STATOR OF INDUCTION MOTOR.

PREVENTION OF "HUNTING."

When the load is increased suddenly the speed decreases momentarily and the motor falls somewhat out of step with the generator; at the same time it takes in more power and comes up to speed again, and may even exceed the synchronous speed, then decrease again, and so on. This is called "hunting," just as in the parallel operation of generators, and is similar to the action of a badly governed steam engine. When hunting once begins, the tendency is for it to become greater and greater unless something occurs to prevent it. This is sometimes accomplished by the use of a fly-wheel loosely attached to the synchronous motor shaft so as to slip as the speed of the motor changes. Another method is the use of a damping frame, which consists of short-circuited copper bars set into the pole faces of the motor parallel to the armature shaft. As the speed of a hunting synchronous motor varies, the direction of the magnetic flux varies and these shifting magnetic lines of force induce currents in the copper bars of the pole faces which oppose the shifting of the magnetic flux and thereby tend to prevent the hunting oscillations.

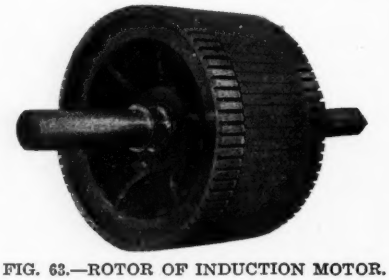


FIG. 63.—ROTOR OF INDUCTION MOTOR.

STARTING A SYNCHRONOUS MOTOR.

The generator and the motor are connected in series with a lamp or other synchronizing apparatus, which may be short-circuited as soon as they are in synchronism. The motor is started from some outside source. For this purpose a small series-wound, direct-current motor will run on an alternating-current circuit, since the magnetism of the fields and armature reverse together as the current changes its direction. Or the machine may be started by a small split-phase motor, which will be described later. The synchronous motor must be properly excited and the switch closed when the rotor reaches synchronism, which will be indicated by a maximum or minimum brightness of the synchronizing lamp, as explained in the synchronizing of generators, in Part IV, printed last week.

THE INDUCTION MOTOR.

The induction type of motor is a kind of transformer, having a short-circuited secondary, capable of rotating within the primary. Instead of passing an external current into the rotating part, as is done in direct-current motors, depending on the reaction between this current and the magnetism of the field to obtain mechanical motion, in this case a current is induced in the rotating secondary.

DETAILS OF CONSTRUCTION.

The induction motor consists essentially of but two parts: A stationary framework called the primary or stator is wound very much like the armature of a revolving-field alternator, as illustrated in Fig. 62, and is connected directly to the mains; the other part, called the secondary or rotor, has ordinarily no external connections and consists of copper bars embedded in an iron core, the ends of the bars being all short-circuited, as shown in Fig. 63.

The rotor core is built up of laminated steel punchings, which are mounted on a cast-iron spider, sometimes having arms shaped to act as fan blades to force air through the motor. Each slot in the iron core contains a single copper bar

which is bolted to a short-circuiting ring at either end. The bars are held in place by overhanging tips of the teeth. The electromotive force generated in the bars is very low, so that the insulation offers no great difficulty. The motor complete is illustrated in Fig. 64.

ADVANTAGES.

The induction motor is at present by far the best type of machine for power purposes on alternating-current circuits. In its adaptability to varying conditions and its general performance it resembles the direct-current, shunt-wound motor, while in simplicity of construction it is far superior. The main advantages of the induction motor are as follows:

1. It starts under load when used with polyphase currents, and requires no synchronizing.

2. It runs at approximately constant speed, regardless of load. In fact, the drop in speed from no load to full load is only slight.

FIG. 64.—INDUCTION MOTOR ASSEMBLED.

3. Having no commutator or brushes and no insulation difficulties, its construction is extremely simple and the cost for maintenance and attendance is therefore less than for any other type of motor.

INDUCTION OF CURRENT IN THE ROTOR.

When an alternating current flows through the primary or stator, a magnetic field is set up, a part of which penetrates the iron core of the rotor. As the field is of an alternating character, corresponding to the alternating current which produces it, it induces alternating currents in the copper bars of the rotor. These currents are quite similar to the eddy currents already described, except that they are here given direction by the copper bars.

This induction of a current in the rotor is an action quite similar to that of an ordinary transformer, as already described, except that in this case the iron core is practically cut in two, part of it being in the stator and part in the rotor. The secondary of the induction motor, of course, differs from that of the transformer in that it is built to rotate.

THE ACTION OF AN INDUCTION MOTOR.

The action of the induction motor is, therefore, as follows: An alternating current flows through the windings of the stator and thereby generates an alternating magnetic field which penetrates into the iron core of the rotor; the conductors embedded within the rotor iron are thus within a reversing magnetic field and have a current induced in them.

The rotor is free to move in a direction at right angles to both that of the current in the rotor and that of the magnetic field of the stator; the result is a transformation of electrical into mechanical energy.

Virginia Passenger and Power.

The committee representing the Virginia Passenger and Power Company, Richmond Passenger and Power Company, Richmond Traction Company and controlled lines, of which Douglas Robinson is the chairman, gives notice to the holders of the first consolidated mortgage bonds of the Richmond Passenger and Power Company, first mortgage bonds of the Richmond & Manchester Railway Company, first mortgage bonds of the South Side Railway and Development Company, first consolidated mortgage bonds of the Virginia Passenger and Power Company, and the bonds and stock of the Richmond & Petersburg Electric Railway, that, because of the appeals which have been taken from the decree directing foreclosure sale, it will not be possible to issue the proposed new securities at once, and accordingly there can be no interest payment due January 1, 1909.

The Appellate Court has advanced these appeals, and set them down especially for argument on January 13, 1909, and it is expected that they will be disposed of early in February, which would enable the scheme of reorganization to be carried out and the new bonds issued within a reasonable time thereafter. At that time all past-due coupons on the new bonds will be paid.

Over ninety per cent of all the securities provided for in the plan of reorganization have already been deposited thereunder.

Meeting of Toronto Section, A. I. E. E.

The Toronto (Canada) Section of the American Institute of Electrical Engineers, at its monthly meeting, December 18, was fortunate in hearing H. G. Stott, past-president of the Institute, and superintendent of motive power, Interborough Rapid Transit Company, New York city, present a paper, "Notes on the Cost of Power."

The speaker dealt very fully with his subject. Complete curves were presented, showing the relation between load-factor and fixed charges for different plant costs, and the cost of power per kilowatt-hour and per kilowatt of rated capacity at all percentages of rated load for steam reciprocating plant, steam-turbine plant, reciprocating and low-pressure steam plant, gas-engine plant, gas-engine and steam-turbine plant and hydraulic-turbine plant. Typical summer and winter railway load curves were then shown, together with typical winter and summer lighting-load curves, and typical industrial curves. These were followed by a series of curves showing the variation in the total cost of power during the day for each of the several plants previously discussed, when operating with the various typical load curves.

The total cost of power and the operating cost of power for the various plants was also graphically shown. The subject matter of the paper proper, in connection with these curves, proved very interesting and resulted in a lengthy discussion in which W. N. Ryerson, Dean Galbraith, Prof. Thos. R. Roseburgh and others participated. The attendance at the meeting was 114.

Peculiar Accident to Power-Plant Flume.

As the result of the freezing of the air vent at the top of the flume of the Litchfield (Conn.) Electric Light Company, fifty feet of the heavy steel tubing was collapsed when employes attempted to empty the down-pipe for the purpose of making repairs. The flume, 200 feet long and four feet in diameter, furnishes waterpower from Bantam's Lake. In shutting down the plant the headgate at the top of the tube was closed, while the turbine end remained partially open. The attendants did not notice that the automatic vent was frozen, and as a result no air could enter to take the place of the water in the tube. The partial vacuum produced caused fifty feet of the steel pipe near the top to collapse like so much paper.

Electrical Notes from Great Britain.

(By our British Correspondent.)

In a paper read before the Birmingham Section of the Institution of Electrical Engineers, Stanley P. Smith, B.Sc., showed the sources of failure and incorrectness of the existing methods of testing alternators on short-circuit. He expounded a method whereby the actual full-load conditions can be exactly imitated and accurately tested on a commercial scale by supplying the total losses, and the accurate temperature rise and efficiency thus obtained. For the sake of comparison, results secured from other methods—notably the Behrend method—were given.

Before the Leeds Section of the Institution, Capt. A. Gardiner, R. E., introduced the subject of "Railway Signaling; Its Defects and Suggestions for Removing Them." Railway experts were present to take part in the discussion.

The address of G. F. Pilditch, the chairman of the Dublin local section, was on the question of electricity supply within purely residential districts. Mr. Pilditch considered the commercial and not the engineering aspect of the matter, and referred to some of the obstacles which tend to prevent a reasonable measure of success from being attained. Poor load-factor he gave as the most vital of all the adverse conditions for a purely residential supply having no tramway load. Practically the only apparent means of improving the load-factor is by an extended use of electric heating apparatus and cooking utensils, but the high initial cost of the apparatus is the consumer's objection; in reply to which the makers say that it is not the cost of the apparatus, but the cost of the wiring. Mr. Pilditch declared that so long as catalogue prices were so high there was no hope in the prospect, however cheap the cooking current might be. In residential districts the long garden approaches to houses made the cost of house-services high. The task of securing new business in such districts is difficult, for few such undertakings can afford to support a separate publicity department. Some cheap means must be adopted to keep the undertaking in touch with the residents. Mr. Pilditch's own experience showed him that it was not sufficient merely to distribute literature broadcast. In Rathmines he issued 2,000 pamphlets on the advantages of electricity in the household. They were designed to look as unlike a trade circular as possible, and a personal letter accompanied each. Only three, out of 2,000, residents, wrote asking for further particulars. He then tried the effect of putting on a canvasser to follow up the pamphlet—a meter reader was selected, because he was acquainted with the district and also knew something of the consumption for the different classes of houses, as well as being versed in the cost of installation work. His remuneration was made dependent upon the results, being based on the additional lamp connections. Since Rathmines has been working in this way, quite a healthy and steady increase in lamp connections has been maintained. The production of suitable literature, on some co-operative arrangement, was advocated. "It is the cumulative effect of the regular distribution of good, entertaining literature that is needed, and without the co-operative principle this is unattainable." A permanent showroom is of more value than a fortnight's attractive exhibition where people will go to while away a pleasant and inexpensive hour. Mr. Pilditch would like to see a permanent showroom where the local wiring contractors can exhibit their fittings under proper conditions in co-operation with the supply authority. Tenants and landlords alike are reluctant to bear the cost of wiring, and to get over this difficulty the speaker said it must be possible for the supply authorities to put in installations free of all cost either to the landlords or tenants, charging a small rental for their use. Referring to the metal-filament lamp, Mr. Pilditch thought it would be a great mistake to increase the price of current on account of a possible decrease in the demand per consumer—to do this would give a decided setback to the industry, in his opinion.

The electric-lamp position quite naturally came in for comment at the recent annual meeting of the Edison & Swan United Electric Light Company, which is the original maker of the Ediswan carbon-filament lamp. This lamp is still being manufactured in the old factories, while a new metal-lamp factory has just been started up. The chairman, Henry Wolfenden, admitted that the increasing use of the new lamps had affected the lamp makers, decreasing the demand for carbon lamps, but it appeared to him to be quite feasible to compensate for this in the future by extending the use of electric light to areas, which, by reason of the expense, had not yet been touched, such as small gas-lighted dwelling houses. Carbon lamps would continue to be used on account of their low price, in places where only short-hour burning would be required, while metal-filament lamps would be used where long-hour burning was needed, on account of their economy of consumption. Electric light had, undoubtedly, been a luxury, and to democratize its use, he said, it was necessary to have, first, an economical and highly efficient lamp; second, a cheap form of house installation, and third, a more simple method of charging for the current supplied. The first has been attained, although finality has not been reached, and the second requirement is in use on the Continent, although the rules of the fire insurance companies do not allow its use in England. British lamp makers have recently announced considerable reductions in the prices of tungsten and tantalum lamps.

As has already been pointed out by the writer in these pages, both electric railroad and tramway fares in the United Kingdom have been reduced to a figure yielding practically no return to the investor on his capital outlay. Competition has been largely responsible for this, but municipal authorities got into the way of charging low tram fares before they knew what the costs of maintenance and depreciation would be, and companies applying for tramway concessions have practically had to do as they were told by the authorities through whose districts they run. Some cities run half-penny fares, but others have shown good sense in avoiding the concession of a costly luxury. It seems to be pretty certain that a raising of fares will come on a number of systems before long. In regard to the tube electric railroads of London, Sir Herbert Jekyll, the head of the London traffic branch of the Board of Trade, has spoken plainly on this point in his report just issued, reviewing the traffic problems of London. Alluding to the excessive competition between the existing means

of transportation, he says: "The price of transportation, like that of any other commodity, cannot long be kept below its commercial value, while the failure to earn a reasonable return checks enterprise and hinders the provision of new facilities for locomotion which, if not required for the moment, cannot fail to be required in the near future." In his reference to tramways, Sir Herbert points out that extension on a large scale, coupled with the unification of the tramway systems and the removal of obstacles to through running, seems at present to offer the best practicable means of dealing with the dense suburban traffic up to a distance of eight or ten miles from the centre of London.

While referring to London tramway matters, we should mention that the Aldgate-Bow route which was equipped on the "G.-B." surface-contact system is again under consideration. It will be remembered that serious complaints were made regarding the safety of the section to the public, and W. M. Mordey, who was asked to investigate matters for the Council, has reported advocating the making of experiments, lasting a few weeks, on half a mile of the route. The cost will be $2,500 and will include the overhauling of the half-mile of track and the modification of the studs, the latter being tested to a definte standard of electrical and mechanical working before being put back. Several cars are to be run over the section at night under trying track and weather conditions. The presence of live studs is to be insured by adding to the mud on the road at a sufficient number of points to enable a thorough trial to be made. The collector will first be used as at present, and then with two exciting coils only. The wood coverings of the collector will be made impervious to moisture by soaking in hot paraffin wax or other impregnating material. It is not considered necessary to change the whole of the studs for this trial, but about fifty cast-steel heads will be put in, mainly to find out how much they improve the contact with the collector, by reason of the better magnetic quality of the steel. Upon the result of this trial depends the future of stud traction in London. At the same meeting at which the above matter was decided, the London County Council placed important contracts for the electrification of further horse sections in North London.

The curtain has just fallen on what may be one of the last acts of the London power play. Once again the season's Bulk Supply scheme is dead, for the House of Commons committee has declared that the preamble of the London and District Electricity Supply bill has not been proved. Year after year the same thing has been happening, and the lawyers and experts have waxed fat—without kicking. Really, after all that had gone before, there appears no valid reason why this year's bill should succeed where previous ones had failed. Some believe that the doubt as to financial backing killed it. Be that as it may, it is dead, and the next step is to hear the existing companies and municipal authorities on the schemes that they have brought forward for linking up their generating stations and networks for mutual benefit and the public good.

BOOK REVIEW.

"Die Elektrischen Eigenschaften und die Bedeutung des Selens für d'e Elektrotechnik." By Dr. Chr. Ries. Berlin. Administration der Fachzeitschrift "Der Mechaniker." Paper. 92 pages. 7 by 10 inches.

To the student following the development of inventions for telephoning over a beam of light and seeing at a distance electrically, as well as to the amateur interested in the remarkable properties of selenium cells—and is there an amateur experimenter who has not at one time constructed a selenium cell after some fashion?—Dr. Ries's compilation of existing data, coupled with his original researches upon "The Electrical Properties of Selenium and Its Significance in Electrotechnology," will offer an amount of detailed information on this attractive subject probably never before assembled on as many pages.

The contents of the book are divided into a number of headings covering the general chemical and electrical properties of selenium, crystallization of the element, construction of photo-electric cells, temperature coefficient of selenium, influence of light upon its sensitivity, lag of resistance behind illumination, influence of the color of the incident light, and the photo-electromotive force of selenium cells. The second section is taken up with practical aspects of the application of the selenium cell. Several methods of telephoning over a beam of light are described and diagrammed, and the transmitted results of different schemes for the electrical transmission of photographs are reproduced and the processes explained.

The field treated is covered with characteristic German thoroughness, and the publication of this volume will prove of service to a host of experimenters in presenting, as it does, about all the information that is known on the very interesting subject of the change of the electrical resistance of selenium with the illumination to which it is subjected.

Lower Cable Rates Do Not Increase Traffic.

Regarding the agitation for lower cable rates between the United States and Europe, George G. Ward, vice-president of the Mackay Companies, says:

"The statement that twenty-five cents per word is a high rate and discourages trade is not in accord with the facts as ascertained by experience. A number of years ago the Atlantic cable rate was reduced to twelve cents per word, and that low rate continued for two years and four months. This thorough and costly test proved that the reduction to such a low rate produced only a ten per cent increase in traffic, while receipts were diminished by nearly fifty per cent in cash. The cable business was done at a loss. The restoration of the twenty-five-cent rate was a necessity.

"Less than one per cent of the public uses the cables, and a reduction in rates would mean increased profits to that one per cent, to the ruin of the cable companies.

"The disposition of the cable companies to meet public requirements is conspicuously shown in their attitude toward code language employed to condense dispatches. More than ninety-eight per cent of cable messages are in cipher code, and each code word may represent as many as twenty plain words, so that the cost of cablegrams is often less than two cents per word.

"Because of the difference in time between Europe and America the business hours common to both countries are only three or four. It is imperative that the cable companies shall have ample facilities to transmit with reasonable dispatch all the business offered during those hours. The consequence is that a great volume of cable business is crowded into those three or four hours, and if cables were unable to transmit it within those hours a large portion would be lost. Were it not for this condition half the cables in the Atlantic would be sufficient to carry all traffic that is offered. This providing of facilities necessary to take care of business at its highest pressure during these three hours is what increased the original capital outlay and makes the expenses of operation and maintenance high."

Electrical Patents in 1908.

By E. G. Siggers.

That no great advance has been made in the electrical world during the past year is to state a fact that should not be discouraging when rightly considered. Slow growth and the piling of one atom upon another is the law of invention in all fields and the normal law of progress. It is only once in a decade or two that a giant piles Pelion on Ossa, and then for another decade lesser workmen are busy smoothing off the ragged surface, filling up lacunæ and obliterating faults, and, further, if the stream of the year's invention be not very deep or swift, it is at least spread out over a very wide area and the total of work done is equally large.

The year gone by has seen no wonders performed in electrical inventions, none of those prodigious steps taken which cause the public to stand agape with uplifted hands, but the public, if it cared to notice, would have seen a host of workers in a score of fields laboring to perfect and improve, each one carrying the world's knowledge and power a step farther, and if not adding a new weapon to man's armory in his warfare with the elements, at least giving to the old one a keener edge, a better point or a more convenient handle.

On looking over the patents granted during 1908, one fact stands out very sharply. In all the fields of inventive endeavor the patent which is assigned to an actually operating company is extremely rare. For one which is so assigned, there are twenty or more which are not and which never will be taken up by practical manufacturers or put into practical operation. In electrical inventions, however, the reverse is the case. The greater proportion by far of these inventions is assigned to the big electrical companies before the patent is taken out. This is of course somewhat the case because these companies employ a staff of highly trained and specialized men to do nothing else but solve problems, and when solved, to patent the method or mechanisms devised; but it also shows that a majority of electrical inventors work along practical lines to certain definite ends.

The Patent Office records show therefore a far larger proportion of useful inventions in electrical art than in all other classes of invention. Electricity is too abstruse a subject for the casual or "crank" inventor to venture on, and as a consequence there are but few silly electrical inventions, though there may be many which will never be applied.

Reviewing the work of the Patent Office in this line during the past year, it is seen that a considerable decrease has been made in the number of electrical patent applications pending, and this not because of any decrease in the number of applications, but rather because of an increased effort on the part of the Patent Office force to bring the work up to time. At the close of 1907 there were nearly two thousand applications pending in the Patent Office divisions having charge of electrical matters. With the termination of 1908 there will be only about fifteen hundred. Of these, the division having charge of electric lighting and general appliances has nearly half, while that dealing with telegraphy and telephony has only about a fifth of the total number. Apparently the figures show that there has been an increase in the number of patents applied for in motors, motor control, generators, railways, etc., and a decrease in those applications dealing with telegraphs and telephones. This is borne out by consideration of the patents issued, a very large proportion of which are on controlling mechanisms and systems. Indeed, motor control seems to have had a larger share of attention this last year than any other field, and next to it, perhaps, come those classes of invention which deal with the automatic telephone systems and appliances connected therewith. Very little was done, comparatively speaking, in car lighting or heating, and a good deal in railway signaling, particularly those signals which are actuated by the power current of a line.

While but few patents were issued in wireless telephony, wireless telegraphy came in for a fairly large share of attention, though little of any great moment was disclosed. It would seem that this branch of the art, and particularly wireless telephony, is in one of those quiescent states waiting for some vital problem to be solved, or for a genius to bridge some gap over which the small fry of inventors may swarm to a further attack. De Forest and Poulsen were the most prominent names in the list, the latter with a method of signaling by which the energy accumulated in an oscillation circuit is periodically brought to act on a wave indicator. This is effected by periodically putting the oscillation circuit out of resonance with the aerial or other circuit to which it is tuned, whereupon the accumulated energy will be itself turned into any path containing therein a telephone receiver.

Another improvement in wireless telegraphy is a receiver devised by Captain Leonard Wildman, United States Army, designed to minimize the trouble usual to detectors of the imperfect-contact type, residing in their tendency to respond to extraneous vibrations and concussions, and so to give false signals.

Among the most novel examples of wireless telegraphy was a system devised by Isidor Kitsee, of Philadelphia, in which the underlying principle consisted in producing an explosion of a gas by the incoming impulses, and through said explosion actuating a circuit closer which is in turn connected to a telegraph sounder. It will be seen that in a sense this is a relay of a kind never heretofore suggested.

In ordinary telegraphy very little has been done in the last twelve months, the most prominent inventions being the printing telegraphs of Delany. Wire telegraphy may have reached the end of its possible adaptation, or be waiting, like Mr. Micawber, for "something to turn up," or, rather, some one to turn up with a new idea. We are liable to say, "this is the end," only to have our words refuted by some studious gentleman who, even while we say it, rises to show us that our Ultima Thule is but the beginning of a new journey. You can never tell what genius may be lurking just around the corner, and herein lies the danger of predicting the end of anything.

While not a great deal was accomplished in electric lighting, if we except generators and systems, yet a number of patents were granted on mercury-vapor lamps and rectifiers therefor, these dealing principally with lamp-starting problems and the dissipation of heat. There were one or two patents granted on static balancers for use with the three-wire systems.

Apparently more and more is being done in electrometallurgy, and while none of the patents granted in this last year upon electrical furnaces would set the world on fire, they were designed to

accomplish other results of far more interest and value in the production of new compounds and the reduction of old. It is noteworthy in this connection that these inventions originate very largely at Niagara Falls, the centre of this field of energy.

It has been impossible in this cursory article to do more than glance at the general trend of electrical invention, and even at that the solid inventions in distribution systems and automatic telephony have been barely alluded to without detailed reference at all, while all the host of smaller inventions, such as conduits, fuse plugs, transmitters, rheostats, etc., have not even been noticed. There is one other device, however, not coming under any general head, yet of considerable interest, which would seem to merit attention in this review as offering a solution of a difficult problem to anyone who considers our present method of determining the light value of lamps. The invention is by William J. Hammer, of New York, and proposes to do away with the variable physiological factor present when estimating light intensities by the eye. Everyone who has engaged in this branch of work knows the difficulty that the personal equation causes, and that differences amounting to as much as ten per cent will exist between the estimates made by different observers with the best available scientific means of comparison and that, furthermore, the color of the light has a great deal to do with these variable estimates. In addition, also, the observer is comparing one fluctuating body with another fluctuating body, for even the best standard lamp will vary under different physical conditions. The solution, according to Mr. Hammer, is very simple. A beam of light from the lamp to be measured is passed through a screen and on the face of a selenium cell which is in circuit with a voltmeter. Previous ratings, of course, have been taken from any of the standard lamps, as the "pentane" lamp, and a standard scale having once been made it is obvious that other lamps can be compared therewith accurately and certainly, without danger of the personal equation cutting in to create an error.

Very much the same idea, at least as far as using a selenium cell is concerned, was suggested in one of the inventions of this last year for the measurement of X-rays, these rays being received upon a fluorescent screen and the light therefrom being received upon a selenium cell.

The inadequacy of such a brief summary as this of the work of the year is patent to everyone, but this inadequacy is quite largely due to the difficulty of selecting from the mass of patents those which will be of abiding value. The relative value of inventions cannot be determined by any survey of the patents granted thereon. This must be left to the test of time and practical experience, and, hence, the real advance in electrical science during the year can best be told by data compiled from the factory and workshop, from the electrical roads and from the great public-service corporations wherein the plans and methods set forth and protected in patents are finally embodied and actually set to work.

Great Falls Waterpower Developments.

Work is progressing rapidly in connection with the 72,000-horsepower developments on the upper Missouri River in the vicinity of Great Falls, Mont.

The diverting coffer dam at Rainbow Falls has been completed so that the engineering force can get into the bed of the river to make their surveys for the power house and head works, and actual construction on the dam is under way. This coffer dam is built of stone and dirt and is not intended to be absolutely tight. A second coffer dam is being built. This will be permanent.

The plans for the dam and masonry work at the head gates are now complete. Those for the power station and machinery contained therein will be made later at the Boston office of Charles T. Main, the engineer in charge of the developments.

An engineering building has been constructed for the engineering force containing a drafting room, living room, sleeping rooms and a bath room. This building will be steam heated and electrically lighted from a temporary plant.

A spur track from the Great Northern Railroad has been built into this plant for a distance of 7,000 feet.

The type of dam which has been designed is a rock-filled timber crib, covering a large area of the bed with a very wide apron. The lumber for the dam has been delivered.

At the Great Falls of the Missouri the programme is practically the same as that at Rainbow Falls. The diverting dam is partially built and the surveys in the bed of the river are being made.

No contracts will be let for the construction work of the dams or power houses, as the Great Falls Water Power and Townsite Company is doing this work with its own superintendent.

Foreign Advertising.

At the recent annual meeting of the Technical Publicity Association, President Charles S. Redfield, advertising manager of the Yale & Towne Manufacturing Company, delivered an interesting address on the subject of "Foreign Advertising."

Mr. Redfield considers that the trade papers abroad can be considerably improved, and that the average business man in Europe will concede that the poor quality of the papers is caused by the lack of the demand for good service in the various industries. A properly conducted trade paper produces its own demand, and then proceeds to fill it. Its mission in America is a definite one, and its place in the business world a definite place. Mr. Redfield spent nearly a month in France, and discovered that it has no strong papers in the hardware and machinery fields, except one or two in the latter, which are rather more scientific than commercial in their aims. In England, however, the conditions are much similar to those in this country. Too strong an expression cannot be made in commending the energy and wide-awakeness of the Germans.

At the present time, for any American manufacturer to attempt to use extensively the trade papers of Europe to push the sale of his product is, in Mr. Redfield's judgment, money poorly invested, unless he has wise and careful agents in the various countries, who are capable of taking and using a certain amount of space, watching it carefully, and, generally, exercising the supervision which can only be given when close at hand.

Corona Phenomena.

To the Editor of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN:

This is to call your attention to an error which appears in your abstract of my paper on the Corona Effect, published in your issue of January 2. On page 25 a formula appears as:

$$E_{eff} = \frac{2{,}055 \times 170 \times .60}{1.41} \times (2r + .07) \times \log_{10} \frac{D}{r} = E_{eff} = 147{,}500 \times (2r + .07) \times \log_{10} \frac{D}{r}.$$

The factor $(2r + .07)$ should appear as $(r + .07)$. This error is practically obvious, but I think it better to have the correction made.

LAMAR LYNDON.

New York, January 4.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

The Mining Exhibition.—The British Mining Exhibition, which was just held at Olympia, London, was a remarkably good one. It was kept open for three weeks instead of one, as in previous years, and there were complaints from some of the exhibitors of its being too long. The small attendance was due, I think, to the fact that the number of visitors was spread over a longer period. Among many of the exhibits it was evident that electricity is steadily making its way, and the principal thing noticed was the steady improvement that is being made in the electrical apparatus manufactured for mining work. Motors are being made stronger and more powerful for every kind of work. Enclosed motors are being used more and more and the parts of other apparatus are being made stronger. The great reason why electrical apparatus sometimes fails in mining works is because the makers or contractors do not sufficiently realize the rough-and-tumble treatment that it has to submit to. As this state passes away, as manufacturers and contractors realize more and more the conditions that have to be worked to, success will be greater.

There is a strong tendency on the part of mining engineers and colliery managers to use compressed air at the face of the coal because of the repeated accidents that have taken place with electricity and because of the danger of firing gas at the face. But the air is now generally compressed close to the face, as close as the conditions of safety will allow, the compressors being driven by electric motors. The electric locomotive has not yet taken its place in mining work in this country, except at a small lead mine in Cumberland. The electric capstan, however, a very good sample of which was exhibited by Dick, Kerr & Co., is likely to prove of service in mines. There are many places both on the surface and underground where a capstan would be very useful, and in those mines which have an electric service, electric capstans might be fixed pretty well anywhere, except where there is gas.

Accidents in Mines from Electricity.—The electrical press on this side has been rather severe of late upon colliery management in connection with accidents that have taken place through the use of electrical apparatus. Unfortunately, accidents, the majority of them fatal, have been increasingly frequent of late, and it cannot be said that they have been less frequent since the promulgation by the Home Office of the special rules governing the use of electricity in coal mines. It will be remembered that when these rules were under discussion I strongly deprecated the detailed manner in which they were laid out.

The accidents that have occurred during the last year or two have claimed for their victims very largely laborers who had no knowledge and pretended to no knowledge of electricity. In almost every case that has occurred, the accidents have occurred through men touching portions of the apparatus that were supposed to have been insulated, but the insulation having broken down, the portion they touched was alive and the usual results followed. The cases have been varied in their character in almost every possible way. A man was killed when moving the haulage rope of a coal-cutting machine because the insulation of the cable connecting the service with the machine had been destroyed. Men have been killed by taking hold of the ordinary bare galvanized-iron signal wires because at some other part of the mine they had become connected with the electrical power service through the insulation of the latter having broken down. Men were killed by clasping armored cables which were supposed to be insulated, but the insulation between the armor and the conductor having broken down the former became alive. There have been other cases, but in all cases, so far as I am aware, it has been the insulation of some part of the plant that has broken down and that has rendered some other part alive that would otherwise be perfectly harmless.

One obvious precaution that might be enforced is to warn all men about the pit never to touch any conductor or any cable of any kind unless they are absolutely obliged to. This precaution would not get rid of all the accidents. It would not have avoided the accident where men caught hold of the signal wires, nor where the man was engaged with a haulage rope, nor again where a man accidentally fell against a cable. But it would get rid of some, and if only a few lives are saved, surely that is something accomplished. Another obvious precaution for colliery owners is to have their men instructed in the elementary principles of electricity. It is not practicable nor would it be advisable to endeavor to make of the, say, three or four thousand men who work about a modern group of collieries skilled electrical engineers, but it is perfectly practicable, at no great cost, to furnish them with a certain elementary knowledge, which, if it does nothing more than give them a wholesome respect for electrical apparatus and a dread of meddling with it, unless they are perfectly sure that it is safe, will have accomplished a great deal.

Further, as every electrical engineer knows, half the troubles with electrical apparatus are caused by very trifling things that a very elementary knowledge would often be able to put right. It is highly desirable that the men be able to ascertain for themselves whether the insulation in any particular case had broken down. It does not require a large amount of skill nor a large amount of experience to know when a cable, for instance, is damaged and when it should be treated with care and respect. It would not be a great matter to give the men employed on haulage roads pieces of insulating tape to carry in their pockets with which they could wrap suspicious-looking places upon cables by the roadside. A very rough and ready wrapping would prevent a large number of the shocks that have taken place.

And all this with a little care and thought on the part of the management and ownership might be extended very largely, and whatever else might result it is quite evident that one thing would be certain, viz., that, while the cost of giving the instruction to the men would be very small, the solid benefit in hard cash to the owners would be very substantial. Bearing in mind that under the Workmen's Compensation Act every man killed may cost colliery owners as much as £300, and that this will give a great deal of instruction of the useful kind to a good many men, the matter is at least worth considering.

The Difficulties of the Colliery Electrical Engineer.—I have remarked above that I think the writers of the articles in the electrical press on this side hardly appreciate the conditions under which the electrical engineer at a colliery has to work. In the first place it must be borne in mind that in a large modern colliery there will be several miles of roads along which cables, junction boxes, etc., may be fixed. In a very large colliery I do not suppose that ten miles of roads would be excessive. Ten miles is not a bad walk on the surface on a nice bright day, not too warm, and with no impediments.

Underground walking is very different indeed from walking on the surface. Some parts of the roads are like caves of the winds, owing to the necessarily large volume of air that has to be driven into the mine for ventilation. Other parts of the mine are very warm and very moist, especially in the deeper mines that rule so largely in the United Kingdom. In walking underground one is sometimes able to maintain the vertical position, but more frequently one would have to perform a certain portion of one's round with one's body very much at right angles. Further, the roads over which one has to walk in a colliery are not designed for walking. They are designed for the colliery wagons to be hauled over. They have the usual rails and sleepers, often pulleys, and the roadbed itself is rarely even; it is often full of holes, etc.

If the electrical engineer who is in charge of the apparatus at a colliery is to keep everything absolutely harmless he must keep up the insulation of the whole of the apparatus, the whole of the cables, motors, joint boxes, distribution boxes, etc., and must examine and test all of them very frequently. I think it will be seen that, supposing it could be done by one man, his life would at least be strenuous. But, as every electrical engineer knows, it would be absolutely impossible for the most careful engineer to make sure of keeping the insulation of the whole apparatus good in the sense that it would be harmless. Supposing that he had made a careful insulation test before going down the pit and had found everything right, and supposing again that he had gone round every part of every apparatus and had found everything apparently right as he came to it, or had put it right. In the working of the average coal mine nothing is more likely than, as soon as he had left some section of the work, some little thing would happen absolutely beyond his control, such as a fall of roof, a little bit of an extra creep, a mine wagon off the track, or something else, so that the insulation of a cable, switch, fuse or junction box that he had just left right, may have been destroyed, and anyone touching the cable or the boxes referred to might receive a fatal shock.

Further, as everyone who is acquainted with colliery work knows, the location of defective insulation in colliery cables and apparatus is by no means an easy matter. It is quite easy by proper insulation tests at the switchboard to know that the insulation of a certain pair of feeders is bad, but it is quite another matter to know where it is bad. Care in observation will enable the electrical engineer in charge to know whether the lowered insulation resistance shown by the test is probably due to a gradual and general deterioration of the cable or to a sudden mechanical injury. In the great majority of cases the latter is the cause, and then it is by no means such a simple matter as it looks to find it. Of course the method of finding it is quite simple, but it entails continual walking to and fro, continual communication with the surface, or the breaking up of the cable into sections, or both. None of this can take place while the pit is working. Everyone who has had anything to do with collieries will know how chary the banksmen are of allowing anyone to go up or down while coal is being wound. In modern collieries the success of the colliery depends very largely upon a certain amount of coal being drawn out during the winding period, and every stoppage is very jealously objected to, as it means so many less tons of coal. In some modern collieries as many as six mine wagons are drawn at once, and the quantity of coal may be as much as nine tons. If a man wants to come up or down it is against the law that coal should come up at the same time, and therefore for every time the electrical engineer or his assistant was going up and down nine tons of coal might be lost to the working day, and those who have had to locate insulation faults in cables will know how many tons might easily be lost if the electrical engineer were allowed to come up and down as often as he liked. Hence testing and locating faults can be done, and has to be done, at night.

The Men to Be Employed as Electrical Engineers at Collieries.—And behind all this there is another very serious problem, and that is, finding the men who can act efficiently as electrical engineers at collieries. I am aware, of course, that there are any number of young fellows, just fresh from a technical college, who are of opinion that they could do the work quite easily. They mean of course that they will try, and no doubt they would try, but trying is one thing and experience, unfortunately, is another, and the colliery can hardly wait while the technical college man is making his experience. To put it plainly also, the work the electrical engineer at a colliery has to do and the conditions under which he has to work are not enticing. Collieries cannot afford to pay high salaries. The class of man that has usually obtained the position of electrical engineer at a colliery has been more of the workingman, or the mechanic type, and it must be acknowledged that he is very much better fitted for the work than the technical college student or one of his education. The large firms who have large iron works and numbers of collieries employ electrical engineers of fairly high standing and are able to pay them fairly well, but these men hardly expect to be called upon to do the work pointed out above, to go through the roads to see that cables, switch boxes, etc., are in order. They will make an occasional inspection, but that will be the utmost they expect to do. As a matter of fact, men who can design work for the collieries and men who are able to look after apparatus at a colliery can usually find work that is very much less severe in its character and at least as well paid. Further, the life in the colliery village is usually not very lively, and young fellows who have been brought up in towns will not probably take to it very kindly.

The result of all this appears to me to be that the problem will work itself out in the same way as the coal-cutting problem has, by the development of a class of colliery electrical engineers, men who are mining men first, or at least who have grown up in a mine and have become electrical engineers afterward, or who have acquired a sufficient knowledge of electrical engineering to keep the colliery plant going. When I was inquiring into the use of coal-cutting machinery some years ago the question of the men who turned out best as drivers or attendants on the machines came up, and I found that the opinion generally was that the miner who acquired a sufficient knowledge to handle his machine was very much the best man to employ. The mechanic who was put to the work was unused to the conditions ruling at the coal face and was very far from it at his best. He was more engaged in looking after his own safety under the (to him) novel conditions than in running the machine at its best; and the same thing will apply to electrical engineers at work in a colliery. The conditions must be novel to them for some time after they arrive at the colliery, and a large portion of their time and attention will be taken up in looking after themselves and there will be very little time to spare for looking after the apparatus. The man, however, who has grown up in the mine will look after himself by instinct and will have all his time and wits ready to look after the apparatus.

PARALLEL OPERATION OF TURBINE-DRIVEN CENTRAL STATIONS.

BY J. E. FRIES.

Parallel operation of power stations where the prime movers are turbines, steam or water driven, offers little difficulties if the load is uniform. Even if energy of varying quantity is drawn at different places from a widely distributed system fed by the stations in question, the

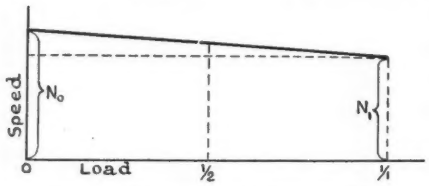


FIG. 1.—SPEED CHARACTERISTICS.

same is true as long as the distance between the load and either of the stations is considerable, compared with the spacing of the latter. In either of these cases the regulation of the turbines may be so adjusted as to cause the generators properly to share in the energy-consuming as well as in the wattless current. Only when the load at times is taken out in the vicinity of one of the stations but far from the other is the operating problem of a more difficult nature.

In order to obtain a clear conception of the conditions that govern parallel operation in such a case, it is expedient to recollect the function of the turbine speed regulator. The tendency of this apparatus is to keep the speed constant within certain limits prescribed by the nature of the load. Almost invariably the ar-

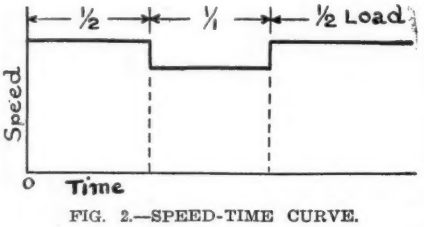


FIG. 2.—SPEED-TIME CURVE.

rangement is such that the lowest speed corresponds to full load and the highest speed to no load. If these speeds are represented with N_1 and N_0, respectively, we may introduce the common definition:

$$\frac{N_0 - N_1}{N_0} 100 = S.$$

S is called the pulsation of the turbine and is evidently the difference between no-load speed and full-load speed in per cent of the former. Thus in Fig. 1 the speed is represented as a function of the load. This velocity may be called the stable speed, which the turbine assumes since the oscillations caused by occasional variations of the load have subdued. The turbine does not at a sudden change of the load immediately pick up the stable speed corresponding to the new output, as shown in Fig. 2, but rather after a few undulations as in Fig. 3. In this connection, however, we need only consider the stable speed.

The form of the speed curve varies with different constructions of the governor, but we will in the following assume a straight line, which generally comes very near the truth in practice.

Each particular load, then, corresponds to a fixed number of revolutions per minute and vice versa. As alternators, operated in parallel, if of the synchronous type, with necessity have a fixed ratio between their speeds this same ratio must exist between the velocities of the driving turbines. Assume now for simplicity's sake that all the generators have the same

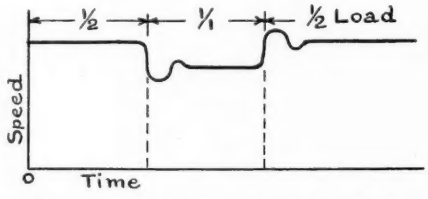


FIG. 3.—ACTUAL SPEED-TIME CURVE.

number of poles, then evidently all the direct-connected turbines must run with identical speeds. Whenever two such aggregates co-operate with governors adjusted to give the same load-speed curve they share equally in the load at all times.

If, on the other hand, the governors are designed and adjusted to give the same speed at no load, but different speeds at full load, as in Fig. 4, where $S_2 = 2\,S_1$, then the turbines divide the load differently: When I is full loaded, II only carries half load; when I carries the load *a*, II carries the load *b*, and so on.

Again, the speed curves may be related to each other, as in Fig. 5, with the same velocity at full load, but different at no load. The turbines now share the load equally at full load speed, but otherwise II carries the greater part. With $S_2 = 2\,S_1$ turbine I runs empty already when the load on II has fallen to one-half.

For different purposes one or other of these three typical arrangements will be selected. Where no reason exists why one unit should contribute more than the other to the total load, identical speed curves are of course used. But if, for instance, in the case of water-driven turbines, one installation has better facilities for economizing with the water than the other, it would then be desirable to let the former station take care of the fluctuating excess only of power required above the full capacity of the latter station.

For two aggregates of equal capacity operating under such conditions and with $S_2 = 2\,S_1 = 5$ per cent (Fig. 6) we might

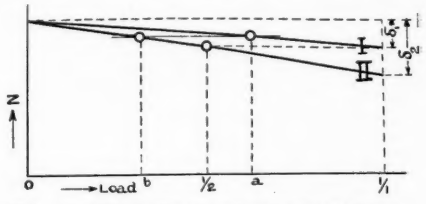


FIG. 4.—DIVERGING SPEED CHARACTERISTICS.

plot a curve showing the relation between the resulting speed of the system and the combined load (Fig. 7), and another (Fig. 8) illustrating the contribution of each set to this load. We see from Fig. 7 that when the total load varies between twenty-five and fifty per cent the speed of the system varies as one unit with a pulsation $S = 3.3$ per cent. Fig. 8 shows that in the meantime unit I varies from zero to 100 per cent of its full-load capacity, whereas unit II only varies between 50 and 100 per cent of its capacity.

It is quite feasible to go even further in this direction. The regulation curves may be thus selected that the highest point for one turbine coincides with the lowest point for the other, the inclination of both lines being the same. Unit II will then remain full loaded until I is relieved of

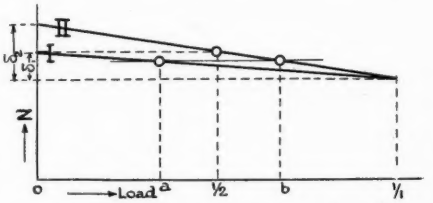


FIG. 5.—CONVERGING SPEED CHARACTERISTICS.

all its load and the total pulsation of the system equals the sum of those of each unit. Assuming $S_1 = S_2 = 2.5$ per cent, the resulting curve is plotted in Fig. 10 and the contribution of each set to the total load is shown in Fig. 11. The combined S evidently is twice the pulsation of each unit operating alone, and between half and full total load one unit delivers invariably its full rated output while the regulation is entirely taken care of by the other unit.

The question in this case arises whether both units ought to be of the synchronous type, or if something might be gained by installing one unit of the asynchronous or induction type. Such an arrangement has frequently been suggested for stations operating in parallel and located far apart,

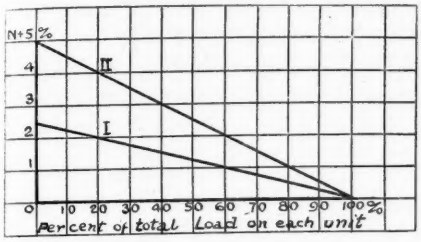


FIG. 6.—PARTICULAR APPLICATION OF FIG. 5.

but as far as the writer knows it has rarely, if ever, actually been employed.

Advantages and disadvantages of such a system may be summarized as follows:

No exciters are necessary in the induction generator station. The generators are here magnetized by the current that, so to speak, links the two stations together. The source of this current may be

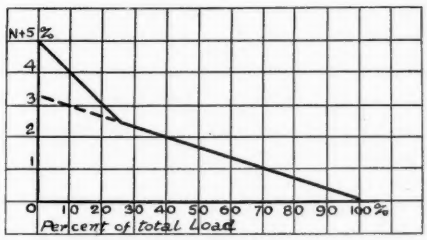


FIG. 7.—RESULTING SPEED AND COMBINED LOAD.

traced to the synchronous generators in the other station and, therefore, indirectly to its exciter sets. The magnetizing current utilized in the induction station must be generated in the synchronous station in addition to that for its own use. It must, however, be considered an advantage not to have to install exciter

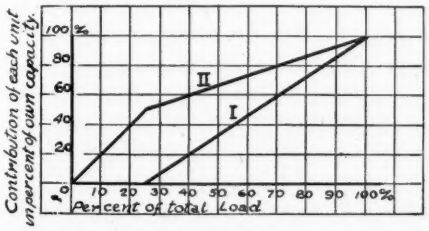


FIG. 8.—DIVISION OF LOAD BETWEEN TWO UNITS.

sets in more than one place with common wiring, switches, instruments, and above all with common supervision. Further, the two stations may be thrown in parallel without synchronizing arrangements. Generally a tachometer is sufficient for the purpose. This fact also tends to decrease the cost of maintenance and supervision. Whether the initial cost of the induction generator with short-circuited armature, the exciter question not considered, is less than that of the synchronous one, cannot be determined once for all. This comparison will often give different results, depending on frequency, capacity, speed, voltage, etc.

On the whole, however, the initial cost will be lowered by building one of the stations of the induction type. Certain it is that the cost of maintenance and supervision is decreased thereby. Reliability of service might also be said to favor the mixed system. Regarding efficiency the common exciters speak for, and the transmission losses of the excitation current against the same system, a somewhat better efficiency of the generators themselves will probably be found with the synchronous type. A positive superiority as to efficiency of one system above the other can hardly be accorded to either once for all.

The principal advantage, therefore, with

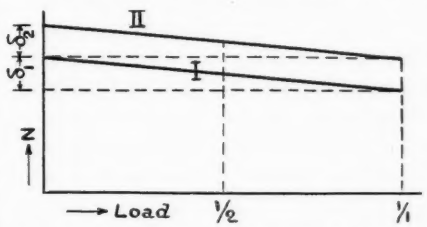


FIG. 9.—PARALLEL SPEED CHARACTERISTICS.

the induction station consists in its less expensive supervision, and even at the synchronous station the operation is simplified, as no attention has to be paid to outside synchronous generators.

What previously has been said in regard to synchronous power stations holds good also with respect to a mixed system, where one station shall operate as constantly as possible under full load and the other take care of the variations. Only one point must needs be further looked into, namely, the relation between the frequency of the system and the speed of the generators. An induction generator has no fixed ratio between these two quantities. If N_0 is revolutions per minute at no load, p number of poles and f the frequency of the current, then $\frac{N_0}{60} \times \frac{P}{2} = f$, as the case is with synchronous generators. If N is the speed during load we have $N = N_0 (1 + \epsilon)$ (for constant frequency), where ϵ is the "lead" of the generator, which quantity within certain limits varies practically in direct proportion to the load. For a large, well-designed induction generator ϵ varies between zero and two or three per cent, while the load varies from zero to full load. We have therefore:

$$N = \frac{120f}{p} (1 + \epsilon)$$

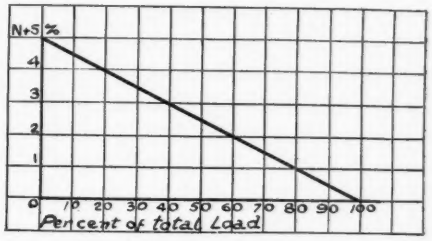


FIG. 10.—PARTICULAR APPLICATION OF FIG. 9.

$$\text{or } f = \frac{p}{120} N \frac{1}{1 + \epsilon}$$

However $\frac{1}{1 + \epsilon}$ is very closely equal to $1 - \epsilon$, if ϵ is very small, as it is in this case.

Therefore $f = \frac{p}{120} N (1 - \epsilon)$, and consequently f decreases with increasing load.

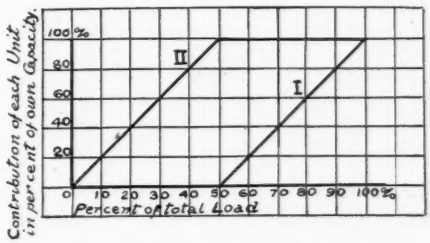


FIG. 11.—DIVISION OF LOAD BETWEEN TWO UNITS.

If we now refer to Fig. 9 and assume unit II to be of the induction type, none of the conditions illustrated in Figs. 10 and 11 are thereby affected, because the speed is here the only dependent variable.

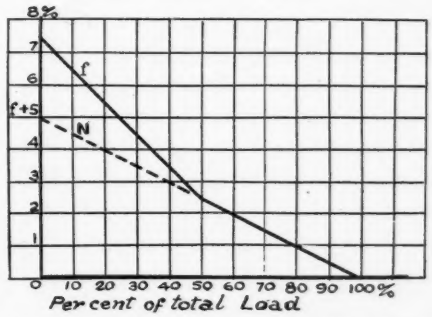


FIG. 12.—VARIATION OF FREQUENCY WITH COMBINED LOAD.

It must be remembered, however, that turbine No. II must be adjusted for a speed as much higher than that of a corresponding synchronous set as indicated by the lead ϵ of the induction generator.

As long as II carries full load, i. e.,

down to one-half of the combined load of the system the frequency is evidently exactly proportional to the speed (Fig. 10). But below this point when energy is given out by set II alone this law is changed. While the load falls from fifty to zero per cent and the speed meanwhile rises 2.5 per cent, the frequency is further increased according to the equation derived above; N grows from N + 2.5 per cent to N + 5 per cent, but simultaneously ϵ decreases from full-load value, for instance, 2.5 per cent to zero; consequently the factor $1 -$ is increased correspondingly. The frequency, therefore, rises from f + 2.5 to f + 7.5 per cent, or a total variation of 7.5 per cent. This condition is shown in Fig. 12.

Both S and ϵ have here been given a low value; when these quantities for some reason or other are larger the total variation of frequency is correspondingly increased. But as the frequency varies, so varies the speed of the motors attached to the system. An induction motor will have even larger possible range of speed variation. If the motor is full loaded, when the system has practically no load, and vice versa, the slip of the motor must be added to the variation just obtained. With a slip of five per cent in a small motor the total possible variation of speed would be about 12.5 per cent. Incidental frequency changes might even further enlarge this figure.

These considerations plainly indicate the importance of designing the turbine installations with an S as low as possible. They also point to the fact that an induction generator makes a good regulation of the frequency harder to obtain. How far this circumstance should influence our choice of generators depends of course on the nature of the load. For railway operation, where synchronous and induction motors in all probability will have a very limited field, this frequency variation is unimportant.

The pulsation of the turbines naturally influences also the voltage directly, but the variations of this quantity is more dependent on other factors, and as automatic voltage regulators will have to be installed anyway, where sudden and large changes in the load are anticipated, this phase of the speed variations is of less practical importance.

The close interdependence between the speed regulation of the turbines and the proper contribution by the alternators to the combined load, as set forth in these simple examples, clearly demonstrate the great difficulties encountered in parallel operation of alternating-current power stations, when located far apart, as compared with the distances to the centers of load. We may imagine a heavy freight train taking a grade near one of the stations. To avoid great ohmic as well as voltage drops this station should principally take care of the train in question. This end may be attained by proper adjustment of the speed regulator. But the next moment a similar load appears in the neighborhood of another station, necessitating a readjustment of the governors if an economical power distribution is desired. In addition, of course, the regulation of the generator fields, in order to maintain proper voltage and power factor, contributes toward making the parallel operation problem a very interesting one to the power station engineer.

Significance of Drafts in Steam-Boiler Practice.

Engineers of the United States Geological Survey express the opinion that it is possible to double or treble the capacity of a steaming plant without making any radical changes in furnaces or boilers, the increase requiring that about double or treble the quantities of air be put through the fuel beds and boilers. The basis for this opinion is set forth in a report by Walter T. Ray and Henry Kreisinger, which has just been published by the Survey as Bulletin 367.

This bulletin is announced as the first of a series of two or three on the significance of drafts in steam-boiler practice, the succeeding bulletins to follow the same lines but to be of more advanced character. The conclusions presented are tentative and are the result of a study of one of the many problems growing out of the general plan of the Survey to increase the efficiency with which the coals of the country are being used. Greater efficiency requires better boiler and furnace design and means a conservation of the fuel resources of the country.

The experiments reported in this bulletin were undertaken with the object of clarifying ideas concerning the passage of air through fuel beds and boilers. Measured weights of air were passed through two beds of lead shot, in series, one of which remained always the same and represented a boiler, the other being varied as to size of shot and depth of bed and representing a fuel bed. Careful observations were made of the weight of air passing through the beds per minute, and all data were platted on many charts so as to permit the study of them from various points of view. A number of laws were deduced bearing on the relative amounts of power required to force air through fuel beds of various thicknesses, composed of various sizes of coal, and through boilers of various lengths and areas of gas passage.

To test the applicability of these laws they were compared with the results of a number of practical experiments made at the St. Louis fuel-testing plant with boilers of the standard hand-fired Heine type, and the principles developed were also studied in connection with the results of certain locomotive tests made at the Norfolk testing plant of the Survey. These various tests and experiments are fully described.

As a result of these investigations the authors believe it may be possible to raise the rate of working the boiler-heating surface to three or even four times its present value. Such an increase would undoubtedly mean new designs of grates, stokers, furnaces and boilers especially fitted for high rates of working.

The Electro-Typograph.

With the development of the electro-typograph and the tele-typograph, it has been possible to take a great step forward in journalism, according to Prof. A. Turpain, of the University of Poicters, France, who has contributed a paper on "The Development of Mechanical Composition in Printing," as a part of the appendix of the annual report of the regents of the Smithsonian Institution.

Professor Turpain describes the various steps taken to aid the printer in setting up his type. Developed little by little, they have finally culminated in the remarkably efficient machine called the electro-typograph, and its cousin, the tele-typograph, by the combination of which not only is the highest mechanical skill obtained, but perforated bands, which, being run through a casting machine, automatically form type, may be reproduced directly by telegraph at any commercial distance.

Thus at the present day, Professor Turpain says, a newspaper article telegraphed from New York, or St. Louis, or San Francisco, in this form, can be received on perforated strips ready for the casting machine in various distant cities, and it is possible for large newspapers to have country editions without increase in expense and without delay.

A New Mountain Railway in Tyrol.

The Rittner line is the latest electrically operated mountain railway to be installed in the Province of Tyrol, Austria. The line is situated to the northeast of the town of Bosen, between the valleys of Eisak and Talfer, and runs up the side of the Rittnerberg and along the plateau on top. This plateau is some 3,000 feet above the level of the town of Bosen. The line is of single track throughout, about eight miles long, and nearly two-and-one-half miles is constructed on the rack principle. Power is supplied to the trains at 750 volts direct current by means of a double overhead contact wire. In order to take advantage of the possibility of recovering energy when the trains descend the rack portion of the line, the motor cars, which are equipped with the usual continuous-current series traction motors, are taken up and down the rack portion by locomotives provided with shunt motors. When the locomotives ascend the rack, the shunt motors act as generators and return energy to the line. On the level portions of the track the motor cars run by themselves. Power for the railway is supplied from a water-power station in the Etsch valley. The substation for the railway is situated halfway along the rack portion, about twenty-two miles from the central station. Power is supplied to the substation in the form of three-phase, alternating current at forty-six cycles and 10,000 volts, on an underground cable laid alongside the track. In the substation the three-phase current is transformed down from 10,000 volts to 3,000 volts by means of a 300-kilovolt-ampere transformer, and is then supplied at this pressure to the 325-horsepower motor of a converting set. This is a squirrel-cage induction motor, and is run from the continuous-current side by means of a battery. The continuous-current machine, which is coupled to the motor with a flexible coupling, generates at 750 volts. The full-load efficiency of the set is given at eighty-nine per cent, with a power-factor of 0.92 and a slip of 1.2 per cent. The battery is connected to the system to take the peaks in the load, and consists of 364 cells with a capacity of 296 ampere-hours on a one-hour rating, or 352 ampere-hours on a two-hour rating. A booster set is provided for charging the battery. The motor of this set is a three-phase induction motor, and is supplied from a transformer which also supplies the station lighting. To start this set a low voltage obtained from a special tap on the secondary of the transformer is impressed on the stator winding of the induction motor. The first portion of the track, about a half-mile in length, runs through the town of Bosen, and is practically level; but in the next two-and-one-half miles a difference in height of nearly 3,000 feet is surmounted, the maximum grade being just over twenty-five per cent. The remaining five miles is practically level again, the maximum gradient being only 4.5 per cent. On the two-and-one-half-mile steep portion the track consists of Vignole rails weighing forty-five pounds to the yard, and the rack is on the Strub system. The rack is laid in lengths of thirteen feet, and the rails in lengths of forty feet. Larch sleepers have been employed instead of the usual iron sleepers. The rail is attached to the sleepers by means of shims and through bolts, which enter about three-quarters of the distance into the sleeper. A turnout is provided in the middle of the rack portion, and the trains each consist of a locomotive and a motor car capable of carrying sixty passengers. There are never more than two trains on the rack portion at the same time. The duplicate contact wire is supported by means of a simple form of bow spring suspension from wooden side poles. The rails are used as return circuit, and the joints are bonded. The rolling stock comprises three rack locomotives, two of which are always in service, the third being a reserve. Four motor cars, three of which are generally in service; two passenger trailer cars, and four goods trailer cars complete the equipment. Each locomotive is fitted with two 150-horsepower, shunt-wound, continuous-current motors, and can develop a continuous output of 300 horsepower at a speed of about four miles per hour and a drawbar pull of about 27,500 pounds. Two toothed driving wheels are used, each one being driven by a motor through double reduction gearing with a total ratio of 14.73 to 1. The spur-wheel axles are connected to the side-wheel axles by connecting rods, and the pitch diameter of the spur wheel must be exactly equal to the running diameter of the side wheels if no slipping is to occur. The tires have been found to wear very little. The rack rail is wedge-shaped in section, in which a gripping device is provided to prevent all possibility of the pinion mounting the rack. An unusual feature in the arrangement is the interposition of a spring between the grip and the locomotive frame. The motors are not coupled direct to the spur-wheel gear, but drive through a coupling which is capable of slipping when the motor torque exceeds a certain amount. The locomotive is provided with two hand brakes which work by means of four blocks on corrugated pulleys on each of the spur-wheel axles. On each armature axle is an automatic brake which comes into action when a certain speed is exceeded; or it can be worked by hand. So long as the contact wire is alive, the locomotive can be braked by regenerating also. The electrical equipment of each motor car consists of two forty-five-horsepower series traction motors with the usual series-parallel control. The four-axle cars weigh twenty-one tons empty, and have a seating capacity of fifty-eight; and the locomotive weighs about 16.3 tons.

LAMP MANUFACTURING IN 1908.

BY L. P. SAWYER.

The year 1908 has not been the very best year lamp manufacturers have ever had. At the same time, considering the general conditions of the country, we have no cause to complain. Since the first of November just past, however, the entire business of the country has taken a decided advance over the same period of last year. I may be somewhat optimistic, but I am looking forward to next year as the very best year by far the lamp manufacturers have ever seen. I firmly believe the lamp business as a total for 1909 will amount to at least $25,000,000. This increase in value is, of course, due to the advent of the new tungsten lamps as well as to the continued increase in business of the tantalum and Gem lamps.

The Buckeye Electric Company is most certainly looking forward to the most prosperous year they have ever had and every indication points to this fact. Our business for the month of December, 1908, shows a very gratifying increase over 1907, and from what I have observed on various trips the past few weeks, I am confident the central-station men are looking forward in the same way to a very prosperous year. Most of the central stations have by this time seen the good policy in maintaining a commercial department, and these commercial departments, I believe, will start out with new energy, ready for more business for 1909 than they have had in the past. Their possibilities are very great indeed, and through their activity, we expect the entire industry to increase to a great extent.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AURORA, ELGIN & CHICAGO.

The report of the Aurora, Elgin & Chicago Railroad Company, for the month of November and five months ended November 30, compares as follows:

	1908.	1907.
November gross	$109,912	$108,653
Expenses	64,969	63,192
November net	$ 44,943	$ 45,461
Charges	27,723	28,033
November surplus	$ 17,219	$ 17,428
Five months, gross	671,466	673,626
Expenses	346,198	351,452
Five months, net	$325,268	$322,174
Charges	138,481	138,549
Five months, surplus	$186,787	$183,625

TWIN CITY RAPID TRANSIT.

The report of the Twin City lines for the month of November and eleven months ended November 30, compares as follows:

	1908.	1907.
November gross	$ 526,574	$ 497,428
Expenses	259,780	264,410
November net	$ 266,794	$ 233,018
Charges, taxes and pfd. div.	143,667	131,142
November surplus	$ 123,127	$ 101,876
Eleven months, gross	5,846,541	5,552,879
Expenses	2,897,697	2,700,434
Eleven months, net	$2,948,844	$2,852,445
Charges, taxes and pfd. div.	1,427,455	1,300,525
Eleven months, surplus	$1,521,389	$1,551,920

NORTHERN OHIO TRACTION.

The report of the Northern Ohio Traction and Light for the month of November and eleven months ended November 30 compares as follows:

	1908.	1907.
November gross	$ 151,934	$ 146,123
Expenses	87,976	88,180
November net	$ 63,958	$ 57,943
Charges	44,012	43,351
November surplus	$ 19,946	$ 14,592
Eleven months, gross	1,731,015	1,761,196
Expenses	1,001,277	1,013,466
Eleven months, net	$ 729,738	$ 747,730
Charges	479,795	469,881
Eleven months, surplus	$ 249,943	$ 277,849

MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company, for the month of November and two months ended November 30, 1908, compares as follows:

	1908.	1907.
November gross	$301,578	$296,184
Expenses	183,382	182,637
November net	$118,196	$113,547
Charges and rents	26,962	27,051
November surplus	$ 91,234	$ 86,496
Two months, gross	630,186	608,083
Expenses	351,506	347,213
Two months, net	$278,680	$260,870
Charges and rents	54,442	54,919
Two months, surplus	$224,238	$205,951

LONDON UNDERGROUND.

The Underground Electric Railways, of London, report gross earnings of the various divisions of the system for the week ended December 5 and twenty-three weeks ended December 5, 1908, compared as follows:

	1908.	1907.
Bakerloo	£ 3,180	£ 2,875
Piccadilly	5,560	5,000
Hampstead	3,480	2,900
District	9,965	8,654
Tramways	5,041	5,366
Total	£ 27,226	£ 24,795
Total, twenty-three weeks	642,064	558,250

CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.

The Central & South American Telegraph Company has issued an estimated statement of income for the quarter ended December 31, 1908.

	1908.	1907.
Gross	$ 415,000	$ 425,000
Expenses	165,000	145,000
Net	$ 250,000	$ 280,000
Other income	4,500	5,000
Total income	$ 254,500	$ 285,000
January dividend	143,565	145,052
Surplus	$ 110,935	$ 139,948
Previous surplus	1,342,550	1,006,499
Total surplus	$1,453,485	$1,146,447

MEXICAN TELEGRAPH COMPANY.

The Mexican Telegraph Company has issued the following statement of estimated income for the quarter ended December 31, 1908:

	1908.	1907.
Gross	$ 172,000	$ 185,000
Expenses	41,000	35,500
Net	$ 131,000	$ 149,500
Other income	25,500	27,000
Total income	$ 156,500	$ 176,500
Mexican government propor.	7,500	7,500
Balance	$ 149,000	$ 169,000
January dividend	71,752	71,752
Surplus	$ 77,248	$ 97,248
Previous surplus	2,624,522	2,059,092
Total surplus	$2,701,770	$2,156,340

DALLAS ELECTRIC CORPORATION.

The report of the Dallas Electric Corporation, including subsidiaries, for the month of October and twelve months ended October 31, compares as follows:

	1908.	1907.
October gross	$ 134,140	$ 125,771
Expenses	73,767	72,290
October net	$ 60,373	$ 53,481
Charges, taxes and sinking fund	27,554	28,481
October surplus	$ 32,819	$ 25,000
Twelve months, gross	1,156,873	1,098,262
Expenses	774,684	761,770
Twelve months, net	$ 382,189	$ 336,492
Charges, taxes and sinking fund	352,150	310,103
Twelve months, surplus	$ 30,039	$ 26,389

NORTHERN TEXAS ELECTRIC.

The report of the Northern Texas Electric Company for the month of October and twelve months ended October 31 compares as follows:

	1908.	1907.
October gross	$ 119,298	$ 114,459
Expenses	56,103	58,164
October net	$ 63,195	$ 56,295
Charges and taxes	15,187	13,386
October surplus	$ 48,008	$ 42,409
Twelve months, gross	1,057,761	1,039,275
Expenses	614,110	587,657
Twelve months, net	$ 443,651	$ 451,618
Charges	185,862	155,112
Twelve months, surplus	$ 257,788	$ 296,506

GALVESTON-HOUSTON ELECTRIC.

The report of the Galveston-Houston Electric Company for the month of October and twelve months ended October 31 compares as follows:

	1908.	1907.
October gross	$ 94,348	$ 89,939
Expenses	52,842	53,520
October net	$ 41,506	$ 36,419
Charges, taxes and sinking fund	20,192	19,671
October surplus	$ 21,314	$ 16,748
Twelve months, gross	1,064,411	1,037,765
Expenses	619,700	606,363
Twelve months, net	$ 444,711	$ 431,402
Charges, taxes and sinking fund	241,761	221,424
Twelve months, surplus	$ 202,950	$ 209,978

SEATTLE ELECTRIC.

The report of the Seattle Electric Railroad Company for the month of October and twelve months ended October 31, 1908, compares as follows:

	1908.	1907.
October gross	$ 401,934	$ 374,379
Expenses	233,624	208,598
October net	$ 168,310	$ 165,781
Charges, taxes and sinking fund	97,085	84,073
October surplus	$ 71,225	$ 81,708
Twelve months, gross	4,453,076	3,994,084
Expenses	2,632,131	2,326,445
Twelve months, net	$1,820,945	$1,667,639
Charges, taxes and sinking fund	1,067,191	875,467
Twelve months, surplus	$ 753,754	$ 792,172

KNOXVILLE RAILWAY.

The Knoxville Railway and Light Company reports earnings for month of November and eleven months ended November 30, 1908, compared as follows:

	1908.	1907.
November gross	$ 47,968	$ 50,712
Expenses and taxes	22,858	25,691
November net	$ 25,101	$ 25,021
Interest charges	11,483	11,420
November surplus	$ 13,627	$ 13,601
Reserve funds	.....	2,500
November balance	$ 13,627	$ 11,101
Eleven months, gross	522,148	549,745
Expenses and taxes	269,104	298,507
Eleven months, net	$ 253,044	$ 251,238
Interest charges	126,468	117,572
Eleven months, surplus	$ 126,576	$ 133,666
Reserve funds	.....	27,500
Eleven months, balance	$ 126,576	$ 106,166

LITTLE ROCK RAILWAY AND ELECTRIC.

The Little Rock Railway and Electric Company reports earnings for month of November and eleven months ended November 30, 1908, compared as follows:

	1908.	1907.
November gross	$ 59,091	$ 57,753
Expenses and taxes	27,956	28,976
November net	$ 31,135	$ 28,777
Interest charges and sinking fund	10,255	8,653
November surplus	$ 20,880	$ 20,124
Reserve funds	3,000	.....
November balance	$ 17,880	$ 20,124
Eleven months, gross	610,195	581,542
Expenses and taxes	310,908	299,912
Eleven months, net	$299,287	$281,630
Interest charges and sinking fund	111,322	92,977
Eleven months, surplus	$187,965	$188,653
Reserve funds	33,000	.....
Eleven months, balance	$154,965	$188,653

MEMPHIS STREET RAILWAY.

The Memphis Street Railway Company reports earnings for month of November and eleven months ended November 30, 1908, compared as follows:

	1908.	1907.
November gross	$ 136,375	$ 125,978
Expenses and taxes	87,510	85,324
November net	$ 48,815	$ 40,654
Interest charges	35,312	34,435
November surplus	$ 13,503	$ 6,219
Reserve funds	2,500	2,500
November balance	$ 11,003	$ 3,719
Eleven months, gross	1,484,286	1,471,071
Expenses and taxes	939,188	916,425
Eleven months, net	$ 545,098	$ 554,646
Interest charges	385,634	370,376
Eleven months, surplus	$ 159,464	$ 184,270
Reserve funds	27,500	27,500
Eleven months, balance	$ 131,964	$ 156,779

BIRMINGHAM RAILWAY.

The Birmingham Railway, Light and Power Company reports earnings for month of November and eleven months ended November 30, 1908, compared as follows:

	1908.	1907.
November gross	$ 188,414	$ 202,141
Operating expenses, taxes	128,699	135,800
November net	$ 59,715	$ 66,341
Interest charges and sinking fund	44,468	42,579
November surplus	$ 15,247	$ 23,762
Eleven months, gross	1,968,509	2,020,031
Operating expenses, taxes	1,299,362	1,340,336
Eleven months, net	$ 669,147	$ 679,695
Interest charges and sinking fund	482,909	436,426
Eleven months, surplus	$ 186,238	$ 243,269

New Haven-New York Central Contract Under Discussion.

A committee of the New York, New Haven & Hartford Railroad Company's directors is considering modification of the agreement by which this railroad uses the tracks of the New York Central terminal from Woodlawn to Grand Central Station, New York city. The company is now paying seven cents for each passenger carried south of Woodlawn and also one-third of the maintenance cost of the Grand Central terminal. To the latter charge it objects as being entirely out of proportion to the facilities afforded to the New Haven road. It is willing to pay the maintenance charges on the facilities it uses, which are much less than one-third of the enlarged terminal.

The new agreement will probably be by way of a compromise between the two systems. It has been estimated that the one-third of the maintenance charges which the New Haven had to bear amounted to about as much as the seven cents a passenger which it pays for the use of the tracks from Woodlawn into the city.

ELECTRICALLY DRIVEN COTTON MILLS OF SOUTH CAROLINA.

BY S. MAYS BALL.

The real and lasting development of cotton mills in South Carolina might be said to have started with the Graniteville cotton mill at Graniteville. The conspicuous figure in the effort to establish this plant, which has been in continuous operation since 1847, was William Gregg, a merchant who accumulated his fortune in the city of Charleston.

About 1847 the Saluda cotton factory, near Columbia, was operating 5,000 spindles and 120 looms on what was known as brown shirtings and "southern stripes," which was a kind of colored cloth used for servants' garments. At the same time there were in operation the DeKalb mills, near Camden, the Vancluse mills, the Mount Dearborn plant on the Catawba River and a yarn mill in Marlboro County. At this time there were two mills in course of construction in the city of Charleston. One of these mills is recorded as having had 3,165 spindles and 100 looms. It was operated by steam.

About 1850 a mill known as the Arlington mill is recorded as having been started in Spartanburg County. It is still in operation. The Saluda Company was organized in 1832 and its great difficulty was its lack of sufficient capital. Mr. Gregg in writing of the situation at Saluda stated that it was capitalized at $50,000, and that the dam alone should have cost that much money; had a similar mill been built in the New England states at that time there would have been at least $400,000 in the treasury before anything was undertaken.

Mr. Gregg must have been in many ways quite an unusual man. In his fifth annual report as president of the Graniteville corporation, which was republished in DeBow's Review for 1855, he lays down these five essential causes for the failure of the cotton-mill industry in South Carolina in his times:

The first is an injudicious selection of machinery and of the kind of goods to be made.

The second is a lack of steady, efficient and cheap motive power.

The third is an injudicious location.

The fourth is the lack of proper effort for the religious and moral training of the operatives.

The fifth is to embark in such an enterprise without sufficient capital.

Getting down to modern times and the real beginning of the present-day success of the cotton-mill industry in South Carolina, the Charleston *News and Courier* in 1880 printed a list of the eighteen cotton mills then operating in the state, which had an aggregate of 95,938 spindles and 1,933 looms.

Today the number of cotton mills in South Carolina operated by steam and electricity is at least ten times as great, and there are today over 3,500,000 spindles in actual operation.

It was not until about 1884-85, however, that the cotton-mill industry of the state began its remarkable development. The next census (1890) was a surprising revelation, showing that in ten years the number of mills had doubled, the number of spindles more than quadrupled, and that the amount of cotton consumed was very little short of four times as great. The progress of the industry since 1890 is even more wonderful, the number of mills having increased from thirty-four to 136, the number of spindles from 332,784 to 2,479,521, or 645 per cent, and the number of bales consumed from 133,342 to 587,126, or 340 per cent, these figures being the ones for 1903, or thirteen years since 1890. It is also a fact that in these thirteen years the percentage of the crop consumed increased from 17.8 per cent in 1890 to 63.4 in 1902-1903.

More substantial and real, but without such large percentages of increase, has been the development for the half decade between 1900 and 1905—109.7 per cent in capital against 252.4 per cent for the period between 1890 and 1900, and 301.3 per cent for the decade between 1880 and 1890, with proportionate increases in the number of wage-earners, cost of materials used and value of products. There were 555,467 bales of domestic cotton used in South Carolina in 1905 as compared with 485,024 bales in 1900, an increase of 14.5 per cent.

From 1905 to 1907 was an equally remarkable period of the history of cotton manufacturing in South Carolina, shown by the figures given below, from the state's Department of Agriculture, Commerce and Immigration:

	1905.	1907.	1908 to Aug. 1.	Per Cent of Increase 1905-'07.
Capital	$82,337,429	$103,821,919	$105,826,919	26
Value of products	$49,437,664	$75,455,019	$77,010,419	52
Cost of material	$34,308,311	.....	.....	.....
No. of wage-earners	37,271	54,887	56,223	47

The list given below shows all of the cotton mills in South Carolina, with loca-

tion and name of president, which are operated wholly or in part by waterpower electrically transmitted:

Aiken Manufacturing Company, Bath, S. C.; Thos. Barrett, Jr.
Anderson Cotton Mills, Anderson; R. E. Ligon.
Aragon Cotton Mills, Rock Hill; Alex Long.
Arcade Cotton Mills, Rock Hill; R. T. Fewell.
Arcadia Mills, Spartanburg; H. A. Ligon.
Batesville Mill, Batesville; Mrs. M. P. Gridley.
Belton Mills, Belton; Ellison A. Smyth.
Belleview Cotton Mills, Rock Hill.
Brandon Mills, Greenville; J. I. Westervelt.
Calhoun Falls Manufacturing Company, Calhoun Falls; W. F. Cox.
Camperdown Mills, Greenville; C. E. Graham.
Capital City Mills, Columbia; Lewis W. Parker.
Hamilton Carhart Cotton Mills, Rock Hill; Hamilton Carhart.
Carolina Mills, Greenville; J. I. Westervelt.
Cherokee Falls Manufacturing Company, Cherokee Falls; J. C. Plonk.
Clifton Manufacturing Company, Clifton; A. H. Twitchel.
Clover Cotton Mills, Clover; G. H. O'Leary.
Columbia Mills Company, Columbia; C. K. Oliver.
Conneross Yarn Mill, Anderson; R. L. Farmer.
D. E. Converse Company, Glendale; A. H. Twitchel.
Courtenay Manufacturing Company, Newry; Campbell Courtenay.
Enoree Manufacturing Company, Enoree; G. S. Coffin.
Fingerville Manufacturing Company, Fingerville; J. B. Liles.
Fork Shoals Manufacturing Company, Fountain Inn; W. P. Nesbit.
Fort Mill Manufacturing Company, Fort Mill; Leroy Springs.
Granby Cotton Mills, Columbia; L. W. Parker.
Graniteville Manufacturing Company, Graniteville; T. I. Hickman (includes Vancluse).
Hermitage Cotton Mills, Camden; H. G. Carrison.
Huguenot Mills, Greenville; R. L. Graham.
Lancaster Cotton Mills, Lancaster; Leroy Springs.
Langley Manufacturing Company, Langley; Thos. Barrett, Jr.
Lexington Manufacturing Company, Lexington; W. P. Roof.
Lockhart Mills, Lockhart; A. H. Moore.
Manchester Cotton Mills, Rock Hill; J. H. Barron.
Manetta Cotton Mills, Lando; B. D. Heath.
Monetta Cotton Mills, Chester.
Mary Louise Mills, Cowpens; B. E. Wilkins.
Norris Cotton Mills, Cateeche; T. M. Norris.
Octararo Mill Company, Clio; C. M. Worth.
Orr Cotton Mills, Anderson; S. M. Orr.
Pacolet Manufacturing Company, Pacolet; Victor M. Montgomery.
Palmetto Cotton Mills, Columbia; W. P. Roof.
Pelham Mills, Pelham; Arthur Barnwell.
Pelzer Manufacturing Company, Pelzer; Ellison A. Smyth.
Pendleton Cotton Mills, Pendleton; D. P. McBrayer.
Piedmont Manufacturing Company, Piedmont; W. E. Beattie.
Reedy River Manufacturing Company, Reedy River; J. H. Maxwell.
Richland Cotton Mills, Columbia; L. W. Parker.
Riverside Manufacturing Company, Anderson; D. P. McBrayer.
Saxa-Gotha Mills, Lexington; Allen Jones.
Tavora Cotton Mills, Rock Hill; S. M. McNeel.
Townsend Cotton Mill, Anderson; H. C. Townsend.
Toxaway Mills, Anderson; D. P. McBrayer.
Tucapau Mills, Welford; J. F. Cleveland.
Tyger Cotton Mills, Fairmont; J. B. Lee.
Union Buffalo Mills, Union; Aug. W. Smith.
Valley Falls Manufacturing Company, Spartanburg; W. P. Roof.
Vardry Cotton Mills, Greenville; L. M. McBee.
Victoria Cotton Mills, Rock Hill; W. J. Roddey.
Victor Manufacturing Company, Greer; L. W. Parker.
Ware Shoals Manufacturing Company, Ware Shoals; B. D. Riegel.
Whitney Manufacturing Company, Spartanburg; J. B. Cleveland.
Williamston Mills, Williamston; Jas. P. Gossett.
Woodside Cotton Mills, Greenville; John T. Woodside.

It is believed that this list of cotton mills employing electric power wholly or in part in combination with steam but using electricity as motive power in some way, kindly furnished the writer by Col. E. J. Watson, Commissioner of Agriculture, Commerce and Immigration, State of South Carolina, is as complete as can be found anywhere.

Among the textile developments and improvements — enlargements, etc.— proposed in South Carolina for 1908 were the following:

Newberry Cotton Mills proposes increase from 28,000 to 38,000 spindles and from 900 looms to 1,200 looms.
Aragon Mills of York proposed to double plant during 1908, which would mean 20,480 spindles and 560 looms.
At Darlington a proposed new mill of 10,000 spindles and 300 looms.
Pendleton Cotton Mills, increase of spindles from 3,136 to 11,000.
Cheraw Cotton Mills, Chesterfield County, proposed new mill of 10,000 spindles and 300 looms.
Calhoun Falls Mill, Calhoun Falls, proposed increase from 16,000 spindles to 25,000 and from 400 to 600 looms.
Lockhart Mills, proposed increase of 3,000 horsepower of waterpower.
Greeleyville Mills, proposed new mill.
Manetta Mills and Highland Cotton Mill, enlargement before end of year.
Tyger Cotton Mills, proposed enlargement during 1908.
Wellford, new mill, $300,000 capital.
Spartanburg, new mill known as Crescent Manufacturing Company.
Blacksburg, Blackburg Mills, organized in 1907 with $250,000 capital, about ready to start with 5,000 spindles, 128 looms and 70 operatives.

Annual Showing of Chicago Telephone Company.

The Chicago Telephone Company began operation under its new franchise on December 1, 1907. A report of its work for the year ended November 30, 1908, has just been completed, which shows 179,386 telephones in service in Chicago on that date, the increase for the year being 35,302. The total amount of wire in use aggregates 442,081, an increase of 85,335 miles during the year.

In private residences there are installed 85,110 telephones, of which 23,645 are on ten-party lines. The number of subscribers on these lines has been reduced by 16,284 during the year, chiefly by changing over to selective four-party service. The number of ten-party lines still in use is 5,602, with an average of a little over four subscribers per circuit. These lines are to be changed to four-party circuits with the new selective ringing during this year.

A total of 7,254 persons is employed by the company in Chicago. Operators, installers and inspectors are trained in schools especially established for that purpose.

In the toll territory immediately surrounding the city the company operates about 50,000 telephones in 110 exchanges. The toll-line system aggregates about 22,500 miles of wire, much of which has been placed in underground conduits extending on the north as far as Milwaukee.

Over the lines of the American Telephone and Telegraph Company Chicago subscribers can telephone over the greater part of the country, having access to practically every city as far west as Denver and throughout the East from Maine to Florida.

Central Pennsylvania Lumber Company.

In the town of Sheffield, Pa., the Central Pennsylvania Lumber Company has located a new lumber mill for sawing rough boards, as well as finished lumber. The total capacity of the plant is about 175,000 feet of lumber per day, largely hemlock. The mill is of concrete construction throughout, securing as great protection from fire as is possible in a woodworking mill.

As is the case with nearly all new mills, electric power has been determined upon for driving the entire equipment. Wherever possible, the machines are direct-connected to their driving motors. Three-phase, sixty-cycle, 400-volt, alternating current was determined upon as being the most satisfactory under all the conditions of service, and a complete power equipment, including boilers, engines, generator, motors, and all the necessary measuring instruments and controlling devices, has been installed, and arrangements made to burn the refuse from the mill under the boilers.

The logs are conveyed up the incline from the pond by a "log chain," or "log-jacker," into the mill, the same being driven by a fifteen-horsepower back-geared motor running at 840 revolutions per minute. The chain is 190 feet in length and carries thirty-three steel dogs for gripping the logs.

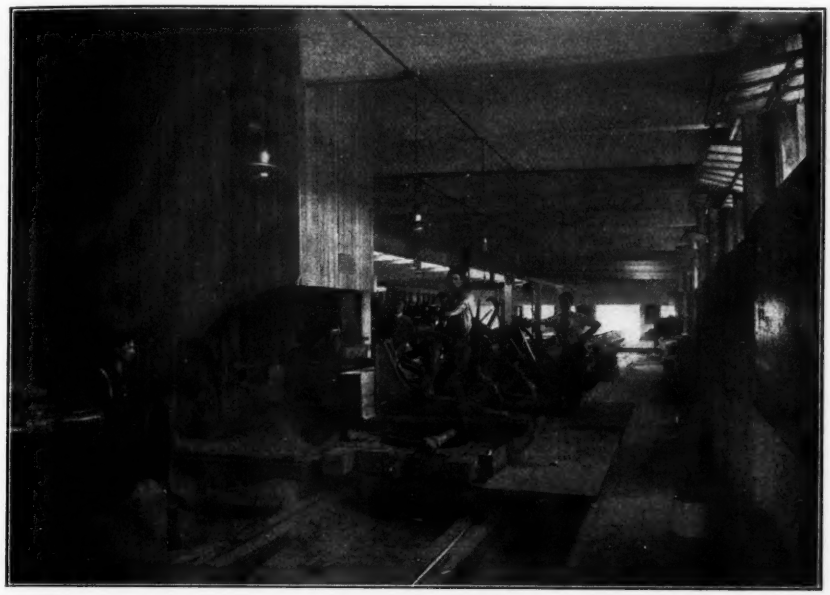
From the top of the incline the logs are rolled either to the right or the left, as the equipment is provided in duplicate; that is, on the right are the band mill, gang edgers and trimmers arranged for receiving the lumber from the left; and there is a similar equipment on the left for receiving lumber from the right.

The logs are first sawed into lumber by the eight-foot band mills, each of which is operated by a 150-horsepower motor running at 580 revolutions per minute. From both the band mills the sawed lumber is carried by line rolls and transfers to the one re-saw mill. Each set of seventeen ten by twenty-four-inch rolls is operated by a seven-and-one-half-horsepower, 1,120-revolution-per-minute motor through a back gear on the motor.

The re-saw mill cuts the lumber into thinner planks and boards, except in the case of the larger sizes, where the first cut by the band mills is sufficient. The re-saw is driven by a 150-horsepower, 580-revolution-per-minute motor. On this re-saw mill are two eight-foot band wheels with fourteen-inch face. The motor is connected by belt to the lower band-wheel

shaft, and gives to the saw a speed of about 9,750 feet per minute.

From the re-saw the one-inch and two-inch material is carried by conveyors to the two gang edgers, which saw the broader boards into standard sizes, as two by four inch, two by six inch, two by ten inch, one by four inch, one by six inch, etc. Each gang edger has eight saws twenty-four inches in diameter, and is operated by a fifty-horsepower, 1,700-revolution-per-minute motor, direct-connected to the shaft of the edger. After the lumber has passed through the edgers it is carried by line rolls to the trimmers, which consist of a row of saws, mounted on swinging arms, driven by belts from a line shaft, from which they are hung. The saws are spaced for trimming off the lumber ends, leaving standard lengths. One trimmer has eight saws and the other ten. Each set is operated by a 30-horsepower motor running at 840 revolutions per minute. The motor also operates a No. 2 Clark Brothers pintle chain for conveying the lumber away.



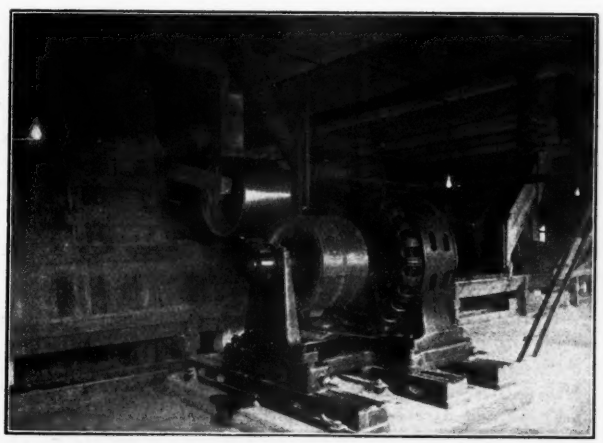
VIEW OF RIGHT-HAND BAND MILL AND CARRIAGE—150-HORSEPOWER MOTOR ON LOWER FLOOR, BELTED UP.

The lumber, after being trimmed, is conveyed on a chain through the assorting shed, where it is loaded on to cars by manual labor. The chain travels at the rate of thirty-two feet per minute, being driven by a fifteen-horsepower, back-geared motor running at 1,120 revolutions per minute.

Provision is also made for the removal of the refuse material by means of conveyors from the different mills. All sawdust is conveyed directly to the boiler room and automatically fired. From the band mills and the edgers the slabs are carried to slasher saws, which are saws mounted on a shaft four feet apart. From the slashers the four-foot lengths are taken, together with other refuse from the mills, with the exception of the sawdust, by conveyors to a machine known as a "hog." A certain percentage of this material, however, before reaching the hog is taken out of the conveyor by hand and loaded into cars for shipment to paper manufacturers. This pulpwood is used in the manufacture of paper and must have a length of sixteen inches and over. The balance of the refuse is cut into chips by the hog, from which it is dumped into cars for shipment to nearby tanneries.

The slasher is operated from a thirty-horsepower, 840-revolution-per-minute motor, which also operates six conveyor chains, each 100 feet in length. The hog is driven by a seventy-five-horsepower motor, 690 revolutions per minute, direct-connected. It has a large rotating element weighing approximately 2,000 pounds, which carries twenty-four knives on a diameter of sixty inches. Owing to the weight of the moving element of the hog, the starting conditions are particularly severe, but the motor, which is of the slip-ring type, brings the machine up to speed quickly without undue overload. The main refuse conveyor for carrying refuse to the boiler room is operated by a ten-horsepower, 1,120-revolution-per-minute motor.

The woodworking equipment was supplied very largely by Clarke Brothers, and the motor equipment by the Westinghouse Electric and Manufacturing Company. The entire equipment represents a very good indication of what can be done by the individual application of electric motors to woodworking machines.



150-HORSEPOWER MOTOR DRIVING EIGHT-FOOT RESAW.

THIRTY-EIGHT-HORSEPOWER MOTOR DRIVING TRIMMERS.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE DISCHARGE OF ELECTRICITY FROM GLOWING BODIES.

This is the title of a lecture delivered before the Manchester Section of the Institution of Electrical Engineers. Since the subject is so closely associated with the ionization of gases, some effects of the latter were considered. If two metal plates separated by air are connected to a storage battery no current flows under normal conditions, but if the dielectric is subjected to X-rays, ionization takes place and a current actually passes through the ionized gas. It is believed that the ionized gas becomes a conductor because X-rays, cathode rays, ultra-violet light, and similar agencies cause a dissociation of the molecules, giving rise to positive and negative particles, which immediately tend to move in two opposite streams, the positive particles going to the negative pole, and vice versa. In the case cited the current increases with increase of potential up to a certain saturation point, beyond which no increase of current results. Ohm's law also fails when it is noticed that reduction of the distance between the plates to one-half its former value reduces the current to one-half, instead of doubling it. As the pressure of the gas is reduced the saturation point is reached much more quickly, due to the more rapid motion of the ions. The breakdown of the dielectric by an electric spark passing from plate to plate is attributed to ionization by collision. If the velocity of the negative ions is greater than about 108 centimetres per second, they are able to generate new ions by colliding with the neutral gas molecules. This effect increases very rapidly with the strength of the electric field. As this approaches a critical value the current, through the gas increases very rapidly with further increase of potential, until the gas breaks down with the passage of an electric spark. That high temperatures produce ionization can be readily shown. Sir J. J. Thomson explains the escape of negative electricity from hot bodies by supposing that the body contains a large number of mobile negative particles or electrons, which are kept from escaping by the action of a "double layer" of electricity formed on the surface. As the temperature rises, some of the electrons acquire sufficient energy of movement to escape from the body and to be conveyed by the electric field to the positive electrode. When the wire is positive it tends to retain the particles. A platinum plate coated with barium or calcium salts has a greatly increased power of emitting electrons, and in this way currents up to one ampere per square centimetre of surface are easily obtained.—*Abstracted from The Electrician (London), December 11, 1908.*

GROUND INDICATOR FOR HIGH-TENSION THREE-PHASE LINES.

Static voltmeters are usually employed in high-tension, three-phase stations as ground indicators. These instruments are quite delicate and expensive. The Felten & Guilleaume Company, of Frankfort, has devised a very simple arrangement applicable to three-phase circuits with star connection, which permits the use of ordinary electromagnetic low-tension voltmeters. The primary terminals of a small step-down transformer, such as are used in connection with measuring instruments, are connected to the high-tension bus-bars, while the neutral point is grounded. (See Fig. 1.) An electromagnetic low-tension voltmeter is connected to the neutral point and the end of each one of the phases. If one of the conductors is grounded and the current loss causes a new distribution of the potentials, the indication of the corresponding voltmeter will decrease, while that of the others will increase. However, it is not necessary to install special transformers for the ground-indicating voltmeters; they may be connected to the same transformers as the measuring instruments in the manner indicated without interfering with the operation of the latter. When the three phases are equally loaded, as when the line feeds only three-phase motors, for example, only two voltmeters are necessary, one for indicating the tension between two conductors, and the other connected on one side to the neutral point of the secondary of the transformer, and on the other to a three-way switch, by means of which the insulation of the three conductors can be tested alternately. (See Fig. 2.) Finally, the ordinary voltmeter, which is indispensable in any case, can also be used as a ground detector by a suitable arrangement of the switch, especially in small stations, where economy is a consideration.—*Abstracted and translated from L'Industrie Electrique (Paris), December 10.*

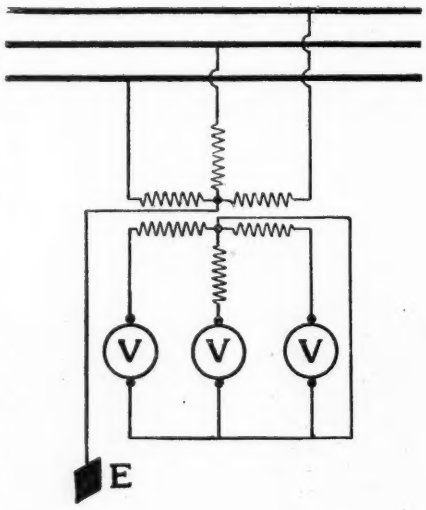


FIG. 1.—GROUND INDICATOR FOR HIGH-TENSION THREE-PHASE LINES.

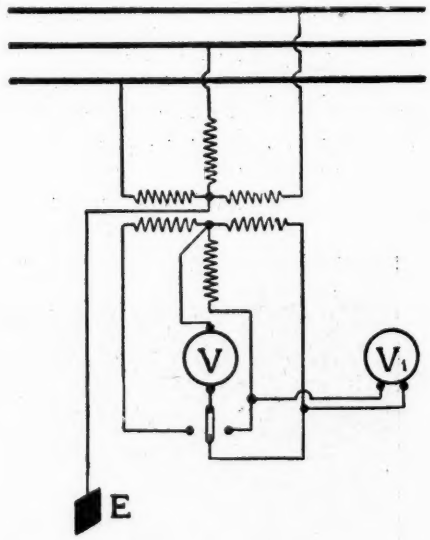


FIG. 2.—GROUND INDICATOR FOR HIGH-TENSION THREE-PHASE LINES.

THE ELECTRICAL EQUIPMENT OF THE NEW YARROW WORKS ON THE CLYDE.

The shipbuilding firm of Yarrow & Company, the work of which dates back as far as 1868, when the firm was established in London, has recently built and equipped a large works at Scotstoun, five miles west of Glasgow, on the north bank of the River Clyde. The engine and boiler shops are equipped with fifty-ton electric overhead cranes, each crane weighing thirty-seven tons, and constructed to lift a working load of fifty tons on the heavy hoist, and ten tons on the auxiliary hoist. The motors are of the reversible, enclosed, ventilated type, fitted with slip rings. The heavy hoist lifting motor gives fifty brake-horsepower at about 750 revolutions per minute, and the auxiliary hoist lifting motor, thirty brake-horsepower at about 250 revolutions; the travel motor, forty brake-horsepower at about 750 revolutions, and the traversing motor, fifteen brake-horsepower at about 750 revolutions. The works are supplied by the Clyde Valley Power Company with three-phase, alternating current, twenty-five cycles, at a high voltage, which is reduced to 400 volts by static transformers. The firm had about eighty-five continuous-current motors in its works at Poplar, and it was consequently decided to establish a motor-generator in the electric substation, to enable these motors to be used at Scotstoun. The capacity of the substation is 700 amperes at 400 to 440 volts, alternating current. Two motor-generators are installed, to be run in parallel; but the continuous-current load is not expected ever to exceed the capacity of one motor-generator. It is intended to adopt alternating-current motors, as far as possible, for any additional plant which may be required. In the substation there are two main switchboards for alternating current and continuous current, respectively. There are separate panels on the alternating-current switchboard for the wet basin and pattern shop, smiths' shop, and for the independent lighting circuits. The power and lighting mains from the substation to the engineering shop, boiler shop, platers' shed, and shipbuilding berths are all carried underground. Bitumen cables are used, and these are laid in creosoted wood troughing run up with bitumen and protected by vitrified tiles. The distribution in the shops is, as far as possible, carried out with bare wires on insulators attached to the roof trusses. The circuits for the arc lighting and incandescent lighting in the various departments are taken from the power mains and are single-phase at 2,300 volts.—*Abstracted from Engineering (London), December 11.*

PROTECTION OF LOW-TENSION CIRCUITS.

Four years ago an Italian association which devotes itself to the introduction of protective measures in industrial establishments offered a prize for a device which would absolutely prevent a permanent rise of tension with respect to earth in industrial current circuits, for the purpose of safeguarding human life. The prize and a gold medal have recently been awarded to Mr. Arcioni, of Milan, and one type of his device applicable to three-phase circuits is described by Gisbert Kapp. Mr. Arcioni based his solution of the problem on the principle, that the protective device must not be limited to the transformer, but that only the line potential with respect to earth must be the determining factor for the operation of the apparatus. The model submitted consists essentially of three alternating-current magnets arranged parallel to, and symmetrically, around an axis. The magnets are half surrounded by short-circuited coils, so that by the well-known screen effect of the poles a rotary force is exerted on an aluminum disc located in front of the poles. In order that the force of the rotating field may remain without effect, the aluminum disc is cut out so that there remain only three wide arms at an angle of 120 degrees to each other. Therefore the disc cannot rotate, but only performs small oscillations, just enough to close a relay contact when the sum of the three rotary forces becomes sufficient to raise a counterweight. The exciting coils of the magnets, which are joined in star arrangement, are connected to the three conductors, and the centre of the star is grounded. Thus each magnet receives, when the insulation of all three phases is equally good or when no excessive tension exists, a tension equal to eighty-seven per cent of the combined pressure. The counterweight is so calculated that it will not be raised under these conditions. Atmospheric discharges have no effect on account of their high frequency. At normal frequency the rotary force exerted by each pole is proportional to the square of the potential with respect to earth. Therefore each displacement of the electrical centre means an increase in the rotary force, and by a suitable choice of the counterweight one may predetermine the amount of the displacement and with it the maximum tension of a phase with respect to earth, at which the relay contact is closed. The relay may be the releasing magnet of the main switch or some other organ, as a short-circuiting arrangement, which disconnects the endangered line.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), December 3.*

THE EMPLOYMENT OF THE EARTH AS PART OF AN ELECTRIC CIRCUIT.

In a paper presented before the International Congress of Applied Electricity at Marseilles, M. E. Brylinski reports on some results obtained by the Committee of Electricity, which investigated this subject under the auspices of the French government. In telegraphy the earth has been used as a return circuit from the beginning, but when electricity began to be used for light and power purposes the government forbade the employment of the earth as a return circuit, as serious disturbances in telegraph and telephone lines were often caused thereby. The object of the investigation was to find ways of avoiding these disturbances, as an enormous saving in copper and other line material would be effected and the difficulties of insulation greatly diminished, if the earth could be used as part of the circuit in power transmission, and longer transmission lines than are at present financially feasible could be established. The obstacles to be overcome in the solution of the problem are the preservation of the ground electrodes, effects of electrolysis, of electrostatic and electromagnetic induction and induction by the ground connections. The different questions are dealt with at length, and formulæ for calculating the effects in advance are established on the basis of experiments carried out over a line between Lancey and Grenoble in 1907. This line is fourteen kilometres long and transmits simple alternating current at 11,000 volts and forty-two periods, the intensity being regulated to about thirty amperes. Parallel lines on which to observe the effects of induction were situated at distances of eight-and-one-half, 480 and 4,857 metres. On the latter line the effects of electromagnetic induction were inappreciable. However, the author states that the formulæ laid down must be verified by experiments made with a line transmitting a larger quantity of energy, say about 100,000 kilowatts, before they can be considered as final.—*Abstracted and translated from La Revue Electrique, Paris, December 15.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Automatic Self Starters for Polyphase Induction Motors.

There has existed for some time a demand for reliable devices to automatically start and control from a distance induction motors operating pumps, air compressors, blowers, etc. The General Electric Company has now on the market a complete line of automatic starters for polyphase induction motors of both the slip-ring and squirrel-cage types in capacities of five horsepower and above for potentials ranging from 110 to 2,080 volts.

FIG. 1.—AUTOMATIC COMPENSATOR—150-220 VOLTS.

In Fig. 1 is shown an automatic starter for squirrel-cage induction motors for 550 volts or less. The apparatus consists of a panel on which are mounted eight alternating-current contactors and a time-limit relay, the starting compensator coils and overload fuses being mounted on the rear of the panel.

A cycle of operation is as follows: The solenoid and relay circuit is closed by means either of a governor, the operation of which depends on air or water pressure, a float switch or an auxiliary push-button switch, or the line circuit can be closed and opened with a double or triple-pole oil switch. In either case, the closing of the solenoid and relay circuits closes five of the eight contactors, the time limit being governed by an air dashpot on the relay. This connects the compensator coils to the line and at the same time connects the motor to the coils, doing automatically that which is accomplished by a hand-operated compensator when the switch is thrown into the starting position. When the plunger of the time-limit relay has reached the end of its travel, it quickly opens the solenoid windings of the five contactors and at the same time closes the remaining three. This latter operation throws the motor directly on the line. When it is desired to stop the motor, the pressure governor, float switch, etc., as the case may be, opens the circuit through the solenoid coils of the three contactors, thereby shutting down the motor. This cycle of operation is repeated automatically and as often as is required to keep the water level at a predetermined point or the air at a certain pressure.

In Fig. 2 is shown an automatic starter for Form "M" or slip-ring type of induction motors. The apparatus consists of a panel, at the top of which is mounted a primary switch consisting of three alternating-current contactors, and below these a three-phase secondary switch operating over three sets of resistance contacts, the resistance being mounted and connected on the back of the panel.

The first step in the cycle of operation is similar to that with the first mentioned type of starter, the circuit through the coil of the solenoid that operates the ratchet being closed by means of a float switch, pressure governor, etc. As soon as this circuit has been closed the three-phase switch is moved forward, the movement of the solenoid plunger being transmitted to the arm by means of a toggle joint which moves a pawl engaging a notched disc fastened to the arm. The rate of movement of the arm is determined by an air dashpot placed opposite the solenoid. When the first contact point is reached a circuit is established through the coils of the three contactors closing them, thus throwing the motor directly on the line with all resistance in the rotor circuit. The three-phase switch still continuing to move over the contacts, as the motor accelerates, gradually cuts the resistance out until the rotor is running short-circuited, which instant the circuit through the solenoid operating the ratchet is broken and the movable switch stops its rotary motion.

The motor continues to run until the tank is full or the air or water pressure is at a certain value or, in the case of remote hand control, when the auxiliary switch or oil switch is opened, at which time the circuit through the contactor

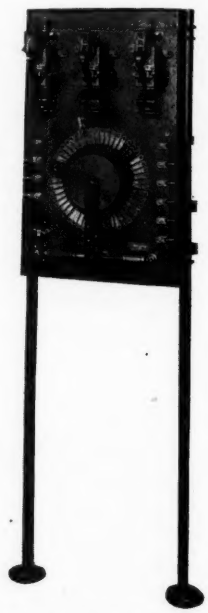


FIG. 2.—SELF-STARTING PANEL FOR FORM M INDUCTION MOTORS.

coils is broken. The contactors then open, shutting down the motor.

When the motor starts again this cycle is repeated, the three-phase arm being advanced forward from the position in which it last stopped. In other words, when the motor has started and stopped three times, a point on one arm of the switch will have traveled the entire distance around the circle formed by the contact points.

In cases where the motor controlled takes an exceedingly heavy current, the three-phase dial switch is used as an automatic master controller for energizing contactors, these in turn cutting out resistance in the motor secondary.

Loading Box Cars by Electricity.

As a means of preventing the theft of coal during transport in ordinary gondola cars many customers have advocated that the coal be shipped in box cars; but often the extra cost of the labor for loading and unloading prevents such shipments being made, except where there is no alternative. Coal must be shipped to the West in box cars only, because coming east there would be no use for open cars which would have to be returned empty, while the box cars can be used for transporting grain. Mechanical loaders have been used to reduce the cost of handling, but in most cases they throw the coal to the ends of the cars, causing considerable breakage, especially in soft coal.

To overcome these difficulties a number of coal companies have installed Ottumwa box-car loaders, which push the coal into place, even to the ends of the cars, and so avoid breakage. Illustrated herewith is such a loader installed at the Silver Creek Colliery of the Philadelphia & Reading Coal and Iron Company at New Philadelphia, O. This is the first installation of the kind in the anthracite region, although this type of loader is much used in the bituminous region. It is driven by a Westinghouse direct-current, type S, series-wound motor, running at 450 revolutions per minute at full load. Power is supplied at 220 volts through two trolley wires, as the track is not used for a return circuit. The motor is controlled by a standard Westinghouse R-32 controller with grid resistance. As it is necessary to reverse the motor at frequent intervals and to run at different speeds, the resistance has sufficient capacity to carry the current for an indefinite period. The motor has a rating of seventy-five horsepower on an intermittent service basis which fully meets the requirements of this case, although it is, in fact, capable of developing much greater torque.

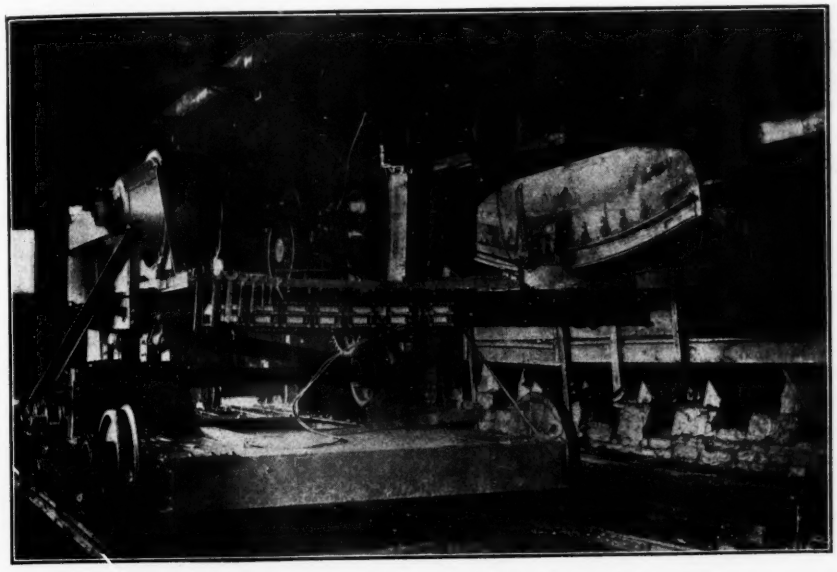


FIG. 1.—OTTUMWA BOX CAR LOADER AND COAL BIN.

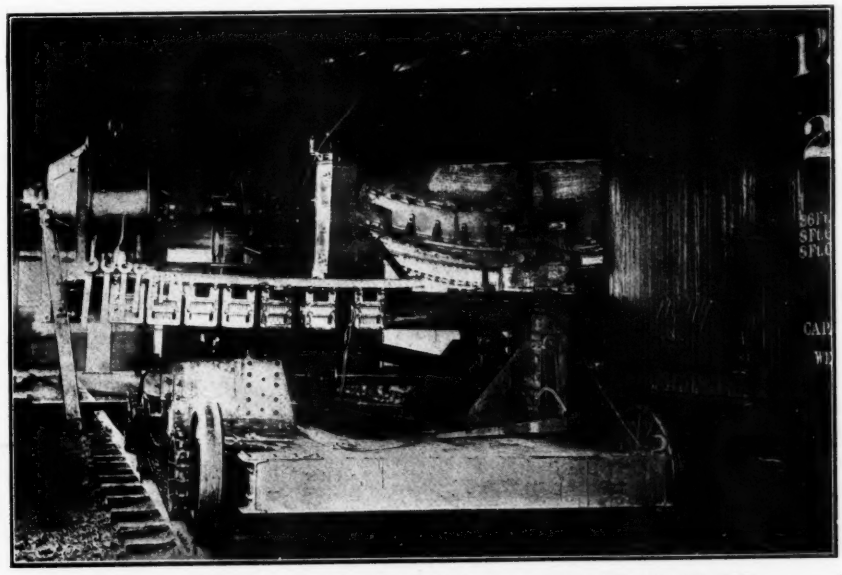


FIG. 2.—LOADER WITH HOPPER TURNED TO ENTER DOOR OF CAR.

Coal is supplied from the overhead bins, shown in Fig. 1, to the hopper, from which it is distributed alternately to the ends of the car, the hopper being entirely inside the car when at work. The hopper rocks up and down and at the same time moves back and forth from one end of the car to the other. As it passes from one end to the other it receives coal from the chute carrying it to the end of the car, where it is emptied by the movement of a scraper which moves through the hopper pushing the coal ahead of it. The motion of the hopper is reversed by reversing the motor, but a mechanical reversing device is used on the scraper.

It is to be noted that all the movements of the scraper and of the hopper inside as well as out of the car and the propulsion of the entire loader from one car to another are obtained from the single motor shown, and are under the control of one operator by means of various clutches and reversing gears, all conveniently arranged for rapid operation. The loader may also be used for moving the cars, loaded or unloaded as required, for this purpose a hook being provided on the truck, into which a rope may be fastened.

This loader at the present time is used for loading chestnut, stove, egg and broken coals, and can handle all other sizes of anthracite coal with equal success. Thirty box cars are being loaded by this equipment in a nine-hour day, and sixty can be handled when conditions require it. The loader puts all but the last few tons into the car, this remainder being filled directly from the chutes.

Opportunities for Publicity.

"The opportunity for securing publicity is practically limitless; it is broad as all knowledge and as deep as human desire," so says Walter B. Snow, Publicity Engineer, of Boston, in the *Selling Magazine*. No product has yet been exploited to the

full, many are the fields that still lie fallow, many are the channels still unexplored. The progressive advertiser is in constant search of new opportunities through which the public may be attracted to and made acquainted with his product, and perchance with himself. His success depends not merely upon finding such opportunities, but upon their specific and proper use to the end that goods may be sold and a reputation established.

"The most casual consideration of the surrounding opportunities for publicity at once brings one to a realizing sense of their magnitude and multiplicity. Anything and everything that serves to impress the name or the quality of the product upon the public mind is available for the purpose.

"While trade catalogues and trade papers, fliers and mailing cards, circular letters and house organs may be classed among the opportunities most generally utilized, it should not be overlooked that a sign upon the building, a machine in operation, the passing comment of a satisfied customer, a business letterhead, or a picture of the plant, a progressive salesman or a persuasive letter, each and all play their part. Some influence is exerted every time the name is seen in print, every time it is spoken; even when the abstract merits of the product are proclaimed without mention of its name, a step forward has been taken.

"So long as publicity was sought through mere reiteration, the means of obtaining it remained extremely limited, but when the function of advertising was fully recognized as fundamentally educational in its character, the field was broadened to its limit. In no line of advertising was this feature earlier and more clearly realized than in that concerned with machinery products, where definite, detailed knowledge of the product is essential to the making of the sale. Here, as a rule, statements may be made with exactness and precision, because they can be founded on facts ascertained by actual test, not upon mere opinions or expressions of sentiment. Here, also, the purchaser usually appreciates to the full their meaning and their economic value to him. As a consequence publicity in technical and engineering lines has long stood as representative of the educational method—a method which is now being employed with increasing frequency in all lines of advertising.

"The technical treatise, the professional lecture or paper, and its reprint, the experimental apparatus in the technical school, the published results of tests and expert investigations, are all distinctly educational. They carry conviction to those who can only be convinced through such means. The advertisement which presents absolute facts, which pictures the method of securing specified results, becomes essentially educational, far more conclusive in its effect than a host of unsupported arguments."

Western Electric Company's Business Good.

The fiscal year of the Western Electric Company ended November 30. Gross sales for the year amounted to almost $36,000,000. During the current year the company has spent about $1,000,000 in new plant.

On the liabilities side the capital stock remains at $15,000,000 and the surplus will not show any marked change from the $18,781,311 for the fiscal year ended November 30, 1907. At the present time the company has on its payrolls about 13,000 persons, as compared with 16,259 a year ago.

The foreign business of the Western Electric Company for the year ended November 30 last, for the most part, held up well. Export commission business in America suffered from the effects of the financial depression, and shipments were at the rate of about sixty-five per cent of normal, gradually improving as the panic died away. The bulk of the Western Electric's foreign business is with the governments of the countries where there is a governmental monopoly of the telephone and telegraph facilities.

The company now has branch connections in London, Paris, Berlin, Antwerp, St. Petersburg, Vienna, Milan, a factory in Tokio and agencies in South Africa and Australia. Recently a representative was dispatched to China, and in time it is expected that the Celestial Kingdom will become an important purchaser of American electrical apparatus. The centuries-rooted dislike for foreigners and innovations is gradually dying away, and China under a progressive ruler would offer a vast field for commercial development.

December, as far as reported, has been a good month for the company. Among the large orders received is a contract with the Packard Motor Company entailing the expenditure of $35,000, and a contract to supply electrical machinery to the Oxford Paper Company, totaling $45,000.

Consolidated Railway Lighting and Refrigerating Company.

The assets of the Consolidated Railway Lighting and Refrigerating Company were sold on December 18 in the New Jersey Court of Chancery, at Jersey City, for $2,008. The balance sheet of the company as of September 30 last, valued these assets at $21,400,817. They consist of 148,421 shares of a total issue of 160,000 shares of the Consolidated Railway, Electric Lighting and Equipment Company and 59,500, of a total issue of 60,000 shares of the Railway and Stationary Refrigerating Company and of the claims against those companies. The company was placed in the hands of receivers in June last by Vice-Chancellor Howell, at Newark, upon application of G. L. Boissevain and C. S. Thorn, and the Allgemeine Trust Company, of Amsterdam, large stockholders.

At the sale, the assets were taken over by a reorganization committee, consisting of Isaac L. Rice, formerly president of the company; A. G. Fromuth, formerly vice-president, and J. L. Watson, formerly secretary and treasurer. The reorganization plan includes the organization of a new company with $8,000,000 of capital divided into 320,000 shares of a par value of $25, shares which are to be exchanged on an even basis with the shares of the present company, par value $100.

To Control Moving-Picture Industry.

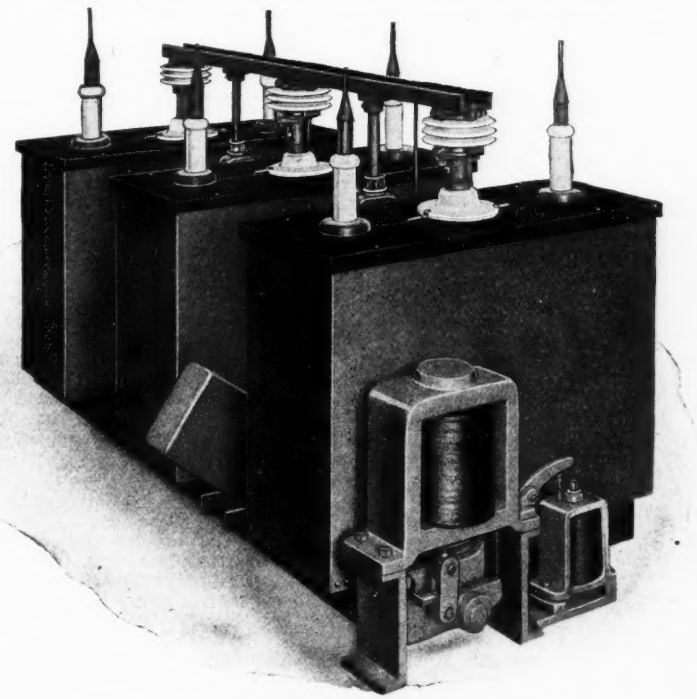
The patents bearing on the manufacture and projection of moving pictures, owned by the Edison Manufacturing Company and the American Mutoscope and Biograph Company, have been purchased by a new company, "The Motion Picture Patents Company." This concern will also control the following patents in addition: The Armat patents for projecting machines, the Jenkins patents, the Pross patents, the Vitagraph patents and the Campbell patents. The officers of the new company are: Frank L. Dyer, president; H. N. Marvin, vice-president; J. J. Kennedy, treasurer, and George F. Scull, secretary. The president and treasurer are connected with the Edison Manufacturing Company, while the vice-president and treasurer are of the Biograph company.

Motion pictures which are manufactured under the license of the Patents company will be leased and not sold. They will be leased for use only on projecting machines which will also be leased by the Patents company.

Electrically Operated Oil-Switch.

The accompanying illustration shows the 30,000-volt, electrically operated oil-switch which has been developed and placed on the market by the Kelman Electric and Manufacturing Company, Los Angeles, Cal. It is made in sizes from 15,000 to 100,000 volts. The switch is entirely self-contained and may be installed in any way desired by simply placing on the floor and connecting up, or in galleries, or in brick or concrete compartments as may be required.

Both the operating solenoids are wound for 110 volts direct current, the closing solenoid requiring approximately 2,300 watts and the opening solenoid approximately 300 watts. The switch is opened by means of springs placed on the guide rods, the opening solenoid being required to simply release the lock which holds the switch in the closed position.



KELMAN ELECTRICALLY OPERATED OIL-SWITCH.

The switch is made non-automatic or automatic as may be required, in the latter case the automatic overload release being actuated by means of series relays which operate by closing the circuit of the opening solenoid, thus tripping the switch. These relays are mounted on insulators which may be installed in any convenient manner. The laminated iron cores are attached to one end of a rod of treated wood, to the other end of which are attached the contacts which serve to close the circuit of the opening solenoid. This wooden rod, in addition to the insulating tube within which the core operates, provides ample insulation at this point.

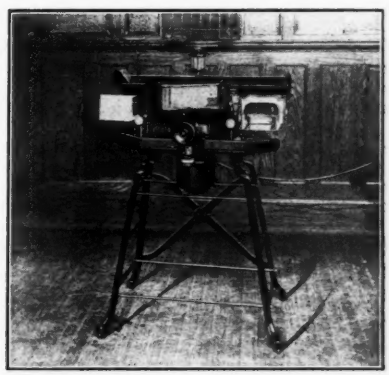
Control of the switch is by means of a small single-pole double-throw switch placed on the switchboard or operating table. Mounted on the switch and operated by it is a small switch which automatically opens the circuit of the closing solenoid as the switch is closed. In the automatic switch the circuits of the operating solenoids are so arranged that if the switch is closed on an overload or short-circuit it will immediately open and will remain open until such time as the operator desires, even though he still holds his control switch in the closing position; in other words, the switch cannot "pump in and out on a short." In the event of failure of the operating current while the switch is in an intermediate position in the act of being closed it will immediately return to the open position. Signal-lamp contacts are provided to indicate the open or closed position of the switch by means of colored lights.

The fixed contacts are secured to porcelain insulators, which are mounted on a wooden support placed well down in the oil; the movable contacts are of the knife-blade type and form part of a simple pantograph by means of which a horizontal break is secured that occurs at a point in the tank which leaves two-thirds of the total volume of oil above the break. This form of contact and switch mechanism has been successfully used for the past five years in Kelman switches. The covers for the oil tanks are made in two pieces, either one or both of which may be readily removed for purpose of inspection of the contacts without disturbing any other part. The entire mechanism in each tank is so arranged that it can be easily lifted out without disturbing the other tanks or without drawing off the oil.

An Electrically Operated Mailing Machine.

A labor and time-saving device which finds a wide application in business houses in handling the outgoing mail is the electrically driven envelope sealer, stamper and counter illustrated on this page. The machine will readily perform its various operations on 150 letters per minute, and may be speeded up to turn out considerably more when required.

The letters in bunches are held against an automatic feed which permits only one envelope at a time to pass its flap over a metal disc which revolves in water. As the envelope advances the stamps are fed forward, cut off, moistened and rolled upon the passing letter. After the envelope flap is moistened and the stamp simultaneously attached the letter passes between a series of rolls under pressure and then emerges and is automatically stacked. A counter records each stamp as it passes upon the envelope, and thus furnishes a check upon the amount spent for postage. Moreover, the stamps cannot be removed from the machine except by the clerk to whom the key is entrusted.



ELECTRICALLY OPERATED MAILING MACHINE.

The Schermack Mailing Machine Company is the manufacturer of this machine, and the Westinghouse Electric and Manufacturing Company furnishes the electrical attachments. As only a one-eighth-horsepower motor is required, the charge for current is negligible.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, DECEMBER 31.—Among the new electric-traction projects which are being considered in France I may mention a tramway line in the neighborhood of Toulon. The Chamber of Commerce of that city has lately made a favorable report on the construction of an electric tramway which will run from Ollioules to Beausset and to the locality known as La Seyne, where are located the naval construction establishments. It is proposed to have a reduced tariff adopted upon this line. The present steam tramway of Las Palmas is to be electrified, having recently changed ownership. The intention is to lay new tracks for the electric line and to erect a power plant of considerable size. The line will be extended as far as the town of Santa Brigida, which lies nine miles to the southwest, and is one of the leading summer resorts of the region.

Among the new companies which have been formed in different cities of France should be noted the firm of E. Hays et Cie., having its headquarters at Paris. This company will devote its business to the manufacture and sale of lighting and heating apparatus by gas and electricity. At Bordeaux there has been formed the Gas and Electric Company of Arcachon and extensions. The new firm of A. and C. Guitton, which will act as a contracting company, is located at St. Etienne. A firm known as the Gas and Electric Company of Villeneuve-sur-Lot, and extensions, has been formed at Paris. The newly-formed Société Electrique du Toulois has its headquarters in the town of Nancy.

At Bilbao, Spain, there has been formed a new company, which is to take up the manufacture of incandescent lamps, erecting a large factory for the purpose. This will be the fourth lamp factory established in this country up to the present time. It is expected that the new factory will be able to turn out 1,000 lamps per day during the first period of operation, but this is likely to be increased to 5,000 lamps per day in the near future. The new company is known as the Industria Electrica.

The Municipal Council of Chateaudun, France, is considering the question of building an electric tramway line, which will run in the suburbs as far as the locality of Oucques. It is also proposed to change over the tramway lines in the town of Nièvre from steam to electricity. A. DE C.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, JANUARY 2.—At Pottsville, Saskatchewan, a company is being formed to construct a rural telephone system. Those interested are all Pottsville men and are headed by J. A. Maharg.

Captain Troup has returned to Victoria, British Columbia, after a conference with officials of the Canadian Pacific Railroad Company, and announces that all ships and coasting vessels of the company on the Pacific Coast will at once be equipped with wireless apparatus.

The Northwestern Telephone Company, which has its head office at Saskatoon, Saskatchewan, has decided not to engage in the construction of long-distance telephone lines, but to leave that work to the Saskatchewan government. The company has recently issued stock to the value of $25,000 for the purpose of assisting in the formation of rural telephone companies.

The Kootenay Telephones, Limited, with head office at Cranbrook, British Columbia, reports that work is being rushed on the construction of telephone lines in the vicinity of Cranbrook. Maurice Quain has severed his connection with the Cranbrook Electric Light Company and has accepted the position of general superintendent of the Kootenay Telephones, Limited. H. C. Routh, formerly of Ottawa, Ontario, has been engaged to look after the business of the Cranbrook Electric Light Company. E. H. McPhee is also a recent addition to the staff of the light company.

A large number of tenders have been received by the city of Winnipeg for the various works in connection with the building of the civic power plant at Lac du Bovnet, which is to cost approximately $3,500,000. These tenders have been handed to the civic power committee for classification and it is not expected that any definite acceptance will be announced for several days. Cecil B. Smith is the civic power expert.

In Revelstoke, British Columbia, any citizen installing an electric light upon the veranda of his house is supplied with current for it free of cost, by the city. Thus Revelstoke is one of the best-lighted cities in Western Canada.

The Winnipeg Electric Company has made another offer to supply power to the city of Winnipeg, Manitoba, for distribution purposes, suggesting that in this way the necessity for constructing a municipal plant at a cost of almost $3,500,000 will be obviated. The company offers to supply power for $24.66 per horsepower on a flat rate. The company also offers to hand over to the city any business it now has with private companies. So far the offer has not been taken up by the City Council, but a number of aldermen are opposed to the acceptance of the offer on the grounds that the City Council is pledged to the construction of a municipal power plant. R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

LARGE HYDRO-ELECTRIC POWER STATION FOR LAPLAND—From several accounts the building of a large new electric power station in Lapland is shortly to be taken in hand. Either the Norr or Soderland Falls will be used. The power available is estimated at 88,000 horsepower.

MERGER OF TUOLUMNE RIVER HYDRO-ELECTRIC INTERESTS IN CALIFORNIA—Under the name of the Tuolumne Water Supply Company, a number of interests holding power claims and water rights along the Tuolumne River in the Sierra Nevada Mountains have consolidated their holdings for the purpose of the more systematic development of the properties involved. The directors of the new organization are Jesse W. Lilienthal, Alexander M. More and Henry H. Hart, of San Francisco. The properties taken over include about 1,000 acres of land, held by William Ham Hall, which is included in the proposed Hetch Hetchy water system for San Francisco; the water rights of G. F. Wakefield, who recently filed on 45,000 miner's inches of water in the Tuolumne River for power purposes; the franchises and water rights of the La Grange Dredging and Power Company, and the holdings of the Sierra Ditch and Power Company. No plans have been announced for the immediate development of the properties controlled by the new company. A.

CITY'S SUIT TO ANNUL UNION ELECTRIC'S FRANCHISE FAILS IN ST. LOUIS—The city's suit to annul the charter of the Union Electric Light and Power Company failed, Judge Taylor sustaining a demurrer filed by the company. "The state's position," explained one of the attorneys for the prosecution, "was that the organization of the Union company, by a series of absorptions of other companies, through the North American Company, was in itself a conspiracy to fix the price. The court's position seems to be that the Union company, being now one concern, cannot conspire with any other corporation. An appeal might develop a different opinion on this point." The Union Electric Light and Power Company was constituted by the successive consolidation of practically all of the electric companies in St. Louis, including the Citizens', Imperial, Missouri-Edison, and several smaller companies. After the creation of the Union Electric, it purchased the franchises, property and business of the Laclede Power Company, thereby completely eliminating competition.

ENGINEERING SOCIETIES.

PAN-AMERICAN SCIENTIFIC CONGRESS AT SANTIAGO, CHILE—Five hundred covers were laid at the official banquet in honor of the delegates to the Pan-American Scientific Congress. Cabinet ministers and the representatives of the foreign powers were among the guests. Special attention was directed by the speakers of the evening to the presence of the delegates from the United States. The American delegates have indicated that they have no wish to hold office in the congress, and this has created an excellent impression, inasmuch as it permits the representatives of the smaller republics to become more prominent in the various discussions.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS—On December 28 and 29 the first annual convention of the American Institute of Chemical Engineers was held at Pittsburg, Pa. The sessions were well attended and a number of inspection trips were made to industrial works in and near Pittsburg. Applications for membership have been received from Spain, Hungary, England and Cuba. The following officers were elected: President, Samuel P. Sadtler, Philadelphia; vice-presidents, Charles F. McKenna, New York, H. A. Hunicke, St. Louis, and Edward G. Acheson, Niagara Falls, N. Y.; secretary, John C. Olsen, Brooklyn; treasurer, William A. Booth, Syracuse, N. Y.; auditor, Richard K. Meade, Nazareth, Pa.

ELECTRIC LIGHTING.

(Special Correspondence.)

BLUE SPRINGS, NEB.—Black Bros. will put in an electric-light plant at Blue Springs. P.

SHERMAN, TEX.—Sherman is to have a municipal electric-light plant to cost $16,000.

WADENA, MINN.—K. Gagne, of Verndale, proposes to supply Wadena with electric lights.

MAYSVILLE, MO.—W. T. Wingate and others will install an electric-light plant at Maysville.

POINT ARENA, CAL.—C. E. Boyd has applied for an electric-lighting franchise at Point Arena. A.

HOOKER, OKLA.—The City Council has voted $20,000 for the construction of an electric-light plant. P.

ROCK HILL, S. C.—R. T. Fewell has taken charge of the Carolina Light and Power Company in Rock Hill. L.

ST. HELENA, CAL.—The city trustees have granted an electric-lighting franchise in St. Helena to Henry Brown. A.

CENTRAL CITY, NEB.—E. A. Hayter will apply for a franchise to operate an electric-light plant at Central City. P.

DASSEL, MINN.—Citizens of Dassel are taking steps to organize a company for the installation of an electric-light plant.

SULPHUR SPRINGS, ARK.—The Sulphur Springs Electric Light Company has been incorporated with a capital of $50,000. P.

MANILA, P. I.—The municipal board of the city of Zamboanga is considering the installation of an electric-lighting system. A.

BARRYTOWN, MICH.—The Barrytown Electric Light and Power Company has been incorporated with a capital stock of $2,000.

SLATEDALE, PA.—The Slatedale Electric Light, Heat and Power Company has been incorporated. It is capitalized at $15,000.

EUGENE, ORE.—An injunction has been issued restraining the City Council from proceeding with work on the municipal power plant. A.

INDIANAPOLIS, IND.—The Tippecanoe Electric and Power Company has been given permission to increase its capital stock from $110,000 to $200,000.

KEOKUK, IOWA—The Keokuk Gas and Electric Company has been incorporated by Frederick Sargent and others, with a capital stock of $300,000. C.

LEWISTOWN, MONT.—The contract for wiring the new courthouse at Lewistown was let to the Fargo Electrical Company, of Fargo, N. D., for $3,300. C.

PALMETTO, GA.—It is understood that B. W. Cochran will apply to the City Council for a franchise to construct and operate an electric-light plant in Palmetto.

NEWARK, OHIO—The Newark Electric Company has been formed with a capital of $10,000 by H. and M. Simonton, F. P. Kennedy, W. C. Wertz and Sprague Horner.

OAKLAND, CAL.—The Seventh Street Improvement Club has contracted with the United Iron Works for the installation of electroliers on Seventh Street, at a cost of $16,000. A.

MODESTO, CAL.—The La Grange Light and Power Company has been awarded a franchise for an electric-lighting and power-distributing system in Modesto, on its bid of $225. A.

MARSHALLTOWN, IOWA—The contract for installing a Detroit system lighting plant of 100-light capacity in the court room at Marshalltown has been let to F. F. Jungkunz. C.

SPOKANE, WASH.—The County Commissioners are advertising for bids for an electric-lighting and telephone franchise recently applied for by Nixon & Kimmel, of Spokane. A.

INDIANAPOLIS, IND.—The Merchants' Heat and Light Company has decided to build a new and much larger plant. The site of the new station is in the west part of the city. S.

TUCSON, ARIZ.—It is reported that the Benson Light and Power Company, of Benson, Ariz., has changed ownership and that the new owners will make extensive improvements. A.

HENRYVILLE, IND.—The Indianapolis & Louisville Traction Company has contracted to light Henryville and Memphis from its power house. The company is now installing the system.

SCOTLAND, S. D.—After having had the matter under consideration since last May, the City Council of Scotland has arranged for the construction and operation of an electric-light system.

RENSSELAER FALLS, N. Y.—The Rensselaer Falls Electric Light and Power Company has been incorporated with a capital stock of $2,000 by Frank Morrison, W. S. Blair, B. F. Morrison and Eugene Morrison.

EAST ORANGE, N. J.—The General Service Heat and Power Company has been formed with a capital stock of $100,000 by J. M. W. Kitchen, Frank R. Wickes and Harry Picking, to generate light, heat and power.

LYNCHBURG, VA.—It is reported that Washington (D. C.) capitalists will organize a company to develop a hydroelectric power on Staunton River, in Campbell County, and that the dam will represent a $350,000 outlay. L.

MILWAUKEE, WIS.—Bids for building a municipal light plant on the Fifth Ward site, to furnish power for 1,000 arc lights of 2,000 candlepower each, will be asked early next month by the Milwaukee Board of Public Works.

OLYMPIA, WASH.—The state building commission announces that as soon as the drawings and specifications are received from the architects a call for bids will be issued for the installation of electric fixtures in the governor's mansion.

HIGH POINT, N. C.—The North Carolina Electric Company, recently purchased by E. D. Steele and others, will soon be reorganized and the original plans of the company put into execution, according to a statement made by Mr. Steele. L.

PEORIA, ILL.—A movement of Peoria business men and property owners on Adams Street, between Hamilton and Bridge streets, is rapidly progressing with a view to installing standards with cluster lights on both sides of Adams Street.

HONOLULU, T. H.—The Department of Public Works has completed plans for a power house in Nuuanu Valley. These call for a sufficient development to furnish lights for the city, and power for pumping water for the municipal reservoirs. A.

FERGUS FALLS, MINN.—The Water and Light Commission, which has charge of the city electric-light plant at Fergus Falls since the first of the year, has reduced the rates for lights from ten cents to seven-and-one-half cents per kilowatt-hour.

ABERDEEN, WASH.—Manager Clary, of the Gray's Harbor Railway and Light Company, announces that soon after the first of the year the company will expend between $10,000 and $15,000 in placing electric lights in South Aberdeen and Cosmopolis. A.

ARBUCKLE, CAL.—William H. Ash will install an electric-lighting plant for the town of Arbuckle. It is his intention to light the Hotel Ash by electricity, and according to his plans he will probably install a plant large enough to furnish light for the town.

LOS ANGELES, CAL.—The Western Water and Power Company has passed into the hands of a new corporation, known as the Glendora Irrigating Company, composed of resident orange growers. The new company has organized with a capital stock of $100,000.

GREENSBORO, N. C.—A charter has been granted to the Randolph Power Company, of Greensboro, to furnish electricity for light and power. The authorized capital stock is $100,000, and the incorporators are C. W. and H. C. Petty and M. W. Parrish, all of Greensboro. B.

ATLANTA, GA.—The Atlanta Power Company has applied for a charter to develop a waterpower on the Chattahoochee River, declaring a $25,000 capital, to be increased when necessary to $1,000,000. E. A. Neely and Alexander King, of Fulton County, are among those interested. L.

PHŒNIX, ARIZ.—F. H. Ensign, general manager of the Phœnix Gas and Electric Company, announces that he has let a contract to the General Electric Company for the electric machinery for the new station in Phœnix. The building for the plant will be of reinforced concrete. A.

BAYONNE, N. J.—The Tidewater Oil Company, which has a large plant in the Constable Hook section, will do away with steam power for its machinery and substitute electricity. According to the company's engineers, electricity will not only be cheaper, but lessen the danger from fire.

HOBOKEN, N. J.—The Mutual Benefit Electric Light and Power Company has applied to the city of Hoboken for a franchise, offering a rate of eight cents per kilowatt-hour to consumers. The company agrees to pay the city three per cent of its gross earnings each year, for a period of twenty years.

SAND POINT, IDA.—The Humbird Lumber Company, of Sand Point, has announced plans for two electric plants, one local and another at Kootenai, in connection with the company's mills at these places. Besides light and power for the mills, light will be furnished to the municipalities and to the public of the towns. A.

OAKLAND, CAL.—A blanket deed of trust covering all the properties of the California Electrical Generating Company, of New York, was filed in Oakland to secure the issue of $5,000,000 in bonds. The company has a capital stock of $7,500,000, one-third preferred and two-thirds common, fully subscribed. Guy C. Earl is president and W. H. Spaulding, secretary, of the company. The members of the company are interested in the Great Western Power Company, which has just completed its first in-

stallation at the Big Bend of the Feather River, and it is assumed that the money raised by the new bond issue is to be used for the further development of the Great Western system. A.

DANVILLE, ARK.—The Danville Electric Company has been granted a charter. The incorporators include D. F. Montgomery, A. M. Falls, C. T. Meadors, George Leming, and others. D. F. Montgomery is president. The object of the company is to furnish light and power for the city, and to establish a waterworks plant. B.

KENTLAND, IND.—The Kentland Light and Ice Company has incorporated with a capital stock of $50,000. The company will build and operate a plant to furnish Kentland with light, heat, power and water. The company, which is in the market for material, equipment and expert labor, is headed by Clearmont Rider, president. S.

STANDISH, MICH.—The Eastern Power Company of Au Sable has been granted a thirty-year franchise by Au Sable and Omer to furnish electric lights and power for operating mills and factories. The company is getting franchises all along the Detroit and Mackinac and some places on the Michigan Central north of Bay City.

ELDORADO, ARK.—The Eldorado Light and Water Company, of Eldorado, Ark., has been incorporated at $50,000, of which the whole is subscribed. The company proposes to purchase and equip a lighting plant at Eldorado. John P. Holmes is president of the company. The incorporators include also S. R. Morgan and J. J. Hudson, of Eldorado. B.

VIESCA, COAHUILA, MEXICO—A contract for an electric plant in the city of Viesca has been signed by the governor, the presidente municipal of Viesca, and Martinez, Delgado y Cia. It is also reported that an electric-light plant in the town of Gral. Cepeda, Coahuila, is contemplated. Particulars can be obtained of H. L. Degener, of Saltillo.

CHICAGO, ILL.—The Commonwealth Edison Company has sold $10,000,000 of five per cent first mortgage bonds to a syndicate of Chicago bankers. The proceeds of the sale will be used to pay for extensions and improvements, as well as for refunding purposes. The syndicate will probably offer some of the bonds to the public within a short time.

BESSEMER, MICH.—A largely-attended citizens' meeting has requested the City Council to investigate the first cost and operating expenses of a municipally-owned electric-light plant. The franchise of the present electric company expires within a year and public sentiment is divided on the issue of granting a renewal, purchasing the old plant, or building a new central station.

CADILLAC, MICH.—Articles of association of the Western Michigan Power Company, with headquarters at Cadillac, have been filed. The company is organized for generating electric power, and doing business in about a dozen counties in and around Mecosta. It is capitalized for $10,000. C. E. Russell, S. W. Kramer and F. H. Mills, of Cadillac, are the organizers and stockholders.

OAKLAND, CAL.—John A. Britton, president of the Pacific Gas and Electric Company, announces the completion of the company's new steam-turbine generating plant at First, Jefferson and Grove streets. The plant has a capacity of 9,000 kilowatts and is housed in a steel-frame fireproof building on a stone foundation. Work on the plant began on July 27. Construction being completed in less than five months. A.

SAN FRANCISCO, CAL.—Patrick Calhoun, president of the United Railroads of San Francisco, has made a statement concerning the recent purchase of the Stanislaus Power Company by the United Railroads, in which he says that the total power development of the power company will reach 64,000 horsepower, or about 40,000 horsepower more than the railroad lines will require. The surplus will be for sale to outside parties. A.

SPARTANBURG, S. C.—The Electric Manufacturing Company, which has developed an electric power at Gaston Shoals, on Broad River, is building transmission lines to Woodruff, S. C., thirty miles distant, to supply the cotton mills there. Preparations are also being made to supply several textile plants at Cowpens. Power for the electric-railway system of Spartanburg, as well as for municipal lighting, is also furnished by this company. L.

CORUNNA, MICH.—Displeased by the village having to be without street lights for three months, the Common Council, at a special session, revoked the franchise of the Shiawassee Light and Power Company, alleging poor service. The company explains that the construction work in connection with the dam at Shiawassee, over Shiawassee River, caused inability to furnish light. The franchise granted originally was for thirty-five years and had eight years more to run. The Commonwealth Power Company and the Jackson & Owoso Light and Power Company are both seeking franchises at Corunna.

GRAND RAPIDS, MICH.—Fire damaged the Donley electric-lighting plant to the amount of $2,000. A short-circuit is supposed to have been the cause. The power house, a small frame structure, was totally destroyed and one dynamo was ruined, while the other is water-soaked and otherwise damaged. The wheel house, at a distance of a couple rods from the power house, is undamaged. The plant will be rebuilt and the damage repaired at once.

LIMA, OHIO—Judge Killits, of Bryan, has forwarded his decision in the recent test case brought by the city solicitor against the board of public service to restrain the erection of a municipal electric-light plant in Lima. The court holds the board is exceeding its powers by attempting to contract for an incomplete or inoperative plant, trusting that the pressure of necessity, or favor of the Council, will produce another authorizing ordinance for more funds.

CHICO, CAL.—A. T. Forward, vice-president, and F. C. Wilson, secretary, of the Sierra Electric Power Company, of Oakland, have established offices at Chico, preliminary to the beginning of construction work on the first of the company's plants at Digger Creek, Tehama County. Mr. Wilson announces that the road to the site of the first plant has been completed and that temporary buildings have been erected. This plant is to develop between 2,000 and 3,000 horsepower. Claims on the waters of Digger Creek have been filed. A.

LOUISVILLE, MO.—Articles of incorporation of the Midland Electric Company, with a capital stock of $100,000, have been filed. The company was organized to utilize the franchise recently bought from the city at public auction for $6,000 by Pendleton Beckley, a Louisville lawyer, who, it was understood, represented a syndicate of eastern capitalists, which has now been formed into a corporation. The company will manufacture and sell electricity for heat, light and power. Lexington is to be the principal place of business. The capital stock is $100,000.

PORTLAND, ORE.—The Portland Water Power and Electric Transmission Company has been incorporated by William H. Hurlburt, formerly manager of the Oregon Water Power Company, together with A. B. Grossman and R. L. Dunham. According to Mr. Hurlburt, who has been made president of the company, more than $1,000,000 will be expended in developing electric power from the water of the Clackamas River for transmission to Portland for light and power purposes. Work is to be commenced as soon as the plans are complete. The company has an authorized capital stock of $1,000,000. A.

JACKSONVILLE, FLA.—The Suwanee River Electric Power Company intends to let construction contracts about February 15. Surveys have been made and right-of-way and capital secured. The company plans to connect Jacksonville with Waycross, Valdosta, Tipton, Ga., and with Lake City, Live Oak and other points in Florida. The Suwanee River will be dammed near White Springs, Fla., to secure power for the operation of a hydro-electric plant. The company has been organized with a capital stock of $3,000,000 for the purpose of operating a series of electric railways extending seventy-five miles in four directions, or 300 miles in all, also for furnishing power for manufacturing purposes to cities within the radius named. W. B. Owens of Jacksonville is president.

OBITUARY.

PROF. BENJAMIN FRANKLIN CLARKE, Professor Emeritus of mechanical engineering at Brown University, died of pneumonia on December 29 at his home in Providence, R. I. Professor Clarke was born in Newport, Me., in 1831, and since his graduation from Brown in 1863 had been connected with the faculty. He was twice acting president of the university.

MR. JEROME CARTY, a well-known lawyer of Philadelphia, Pa., died on December 30 at the Samaritan Hospital in Philadelphia, where he had been taken while suffering from a second stroke of apoplexy, the original attack having seized him several months ago while in the West. He was born at Springfield, Pa., in 1845 and graduated from the University of Pennsylvania in 1866. In 1872 he began the practice of law under his own name. Mr. Carty occupied a prominent position in Europe and the United States in the telephone litigation in opposition to the Bell Company, taking an active part in various arguments in which he was associated with Col. Robert G. Ingersoll.

NEW PUBLICATIONS.

PROCEEDINGS OF THE OHIO ELECTRIC LIGHT ASSOCIATION, 1908—The proceedings of the fourteenth annual convention of the Ohio Electric Light Association, held at Put-in-Bay, Ohio, August 25, 26 and 27, together with the papers there presented, and the list of officers and members, has been published by the association, of which D. L. Gaskill, Greenville, Ohio, is secretary. The volume is uniform with the Ohio association proceedings of previous years.

PERSONAL MENTION.

MR. HARRY A. JASTRO has been appointed manager of the Bakersfield (Cal.) plant of the Bakersfield Power, Transit and Light Company, to succeed the late James Goodwin.

MR. JOHN C. HONECKER, of Trenton, N. J., has resigned as the manager of the Pennsylvania & New Jersey Traction Company, and will become identified with a manufacturing company at Reading, Pa.

MR. GEORGE E. HANSCOME, master electrician of the Mare Island Navy Yard, Vallejo, Cal., has returned from Alaska, where he finished the installation of a new wireless telegraph station near Valdez.

MR. JOHN F. DRYDEN, president of the Prudential Insurance Company, has re-entered the directorate of the Public Service Corporation of New Jersey. He takes the place made vacant by the death of E. F. C. Young.

MR. W. N. RYERSON, superintendent of the Ontario Power Company, has resigned his position at Niagara Falls to take that of general manager of the Great Northern Power Company, of Duluth, Minn. Mr. H. H. Wilson, who has been his assistant, may become his successor.

MR. WALTER S. BISSELL, who, January 1, became treasurer of the F. Bissell Company, Toledo, Ohio, has been associated with the company for a number of years as traveling salesman, and brings to his new position a thorough knowledge of the electrical trade and an intimate and extended acquaintance.

MR. THEODORE P. SHONTS has been made president of the Interborough Rapid Transit Company to succeed E. P. Bryan, resigned. Mr. Shonts assumed his new position on January 1. For some time he has been chairman of the executive committee of this company, as well as president of the Interborough-Metropolitan Company.

MR. G. S. SHINNICK, formerly assistant district superintendent of the Ohio Electric Railway Company, at Columbus, Ohio, has become general manager and purchasing agent of the Mattoon Heat, Light and Power Company and the Mattoon City Railway Company, Mattoon, Ill. Mr. Shinnick was at one time connected with the Licking Light and Power Company, of Newark, Ohio, as secretary and director.

MR. ISHAM RANDOLPH, formerly chief engineer of the Sanitary District of Chicago, and under whose direction most of the construction work of the Chicago drainage canal was carried out, has been appointed a member of a commission of six prominent engineers that will accompany President-elect Wm. H. Taft on a trip of inspection of the Panama Canal. The party will sail from Charleston, S. C., on January 25 and will advise Mr. Taft on the engineering work now being carried out, particularly, it is believed, with reference to the work on the Gatun Dam.

PROPOSALS.

POST OFFICE BUILDING AT CLARINDA, IOWA—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until February 8, for the construction complete of the United States Post Office at Clarinda, Iowa, in accordance with the specifications, which may be had at the office of the postmaster at Clarinda or at the office of the Supervising Architect.

ELECTRICAL SECURITIES.

There was another short week in the stock market, due to the end of the holiday season, but during this period there was great activity, with the firm undertone of the previous week well maintained. The bearish indications and money flurry usual with the end of the year were absent, and reports of general trade improvement sustained prices and made way for more progress early in the new year.

Dividends have been declared upon the following electrical securities: Aurora, Elgin & Chicago; regular quarterly dividends of one-and-one-fourth per cent on the preferred stock and three-fourths of one per cent on the common stock, both payable January 11. United Traction Company of Pittsburg; regular semi-annual dividend of two-and-one-half per cent on the preferred stock, payable January 20 to stock of record January 9. Radio Telephone Company; regular quarterly dividend of one per cent and an extra dividend of two per cent, making a total of three per cent on the par value of all stock on which full cash payment has been made prior to January 1, 1909; dividend checks mailed January 15. Manchester (N. H.) Traction Light and Power Company; regular quarterly dividend of $2 per share, payable January 15 to stock of record January 1. National Carbon Company; regular quarterly dividend of one per cent on the common stock, payable January 15. Standard Underground Cable Company; regular quarterly dividend of three per cent, the regular annual extra dividend of three per cent out of earnings, and an extra dividend of seven per cent out of accumulations. Cincinnati, Newport and Covington Light and Traction Company; quarterly dividend of seven-eighths per cent on the common and one-and-one-eighth on the preferred, payable January 15. Consolidated Traction of New Jersey; two per cent, payable January 15. United Railways of St. Louis; quarterly dividend of one-and-one-fourth per cent, payable January 11. Shawinigan Water and Power; one per cent, payable January 20.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JANUARY 2.

New York:	*Closing.*
Allis-Chalmers common	15⅝
Allis-Chalmers preferred	49¾
American Tel. and Tel. Company (ex. div.)	127½
Brooklyn Rapid Transit	67¾
General Electric	157½
Interborough-Metropolitan common	17¾
Interborough-Metropolitan preferred	46
Kings County Electric	126
Mackay Companies (Postal Telegraph and Cable) common	75¼
Mackay Companies (Postal Telegraph and Cable) preferred	70
Manhattan Elevated	153
Metropolitan Street Railway	40
New York and New Jersey Telephone	110
Western Union	68¾
Westinghouse Manufacturing Company	85¼

For the first five months of the fiscal year of the Brooklyn Rapid Transit Company, to December 1, gross earnings fell off $370,000. Expenses were reduced, however, to such a figure that the loss in net earnings for the five months amounted to but $85,000. December gross shows very substantial increases. Up to December 24 it was $26,000 ahead of the whole month in 1907, and net earnings should also show a very substantial increase.

Although the annual report of the New York and the New York and New Jersey Telephone Companies is not yet completed, the earnings for the year now closing show a gain over that of any previous year. On account of the general retrenchment in all lines of business during the greater part of the year 1908, the number of new telephones installed fell considerably below the totals for new business in both 1906 and 1907, but this loss, it is said, was almost entirely confined to the cheaper grades of service and lasted less than twelve months. The number of stations in service in the Metropolitan district on January 1, 1896, was 28,043. On October 1, 1908, the latest figures available show this total to be increased to 420,173. This steady growth has reached its present strength by yearly leaps as follows: 1897, 34,081; 1898, 42,958; 1899, 52,897; 1900, 71,681; 1901, 95,299; 1902, 121,608; 1903, 158,792; 1904, 197,981; 1905, 237,993; 1906, 301,890; 1907, 362,143.

Boston:	*Closing.*
Edison Electric Illuminating	250
Massachusetts Electric	58½
New England Telephone	126½
Western Telephone and Telegraph pref.	80
Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	45
Electric Storage Battery preferred	45
Philadelphia Electric	11¾
Philadelphia Rapid Transit	25⅜
United Gas Improvement (ex. dividend)	92⅞
Chicago:	*Closing.*
Chicago Telephone	128
Commonwealth Edison	107¼
Metropolitan Elevated preferred	48
National Carbon common	85¾
National Carbon preferred	112

The Metropolitan Elevated December traffic was 4,583,85, or 4,444 increase; daily average, 147,146, or 0.9 per cent, increase.

The South Side Elevated's December traffic was 3,845,524 passengers, or 132,109 increase. Daily average, 124,049, or 3.56 per cent, increase.

Northwestern Elevated's December traffic was 3,783,946 passengers, or 499,235 increase. Daily average, 122,063, or 15.2 per cent, increase.

The Chicago Telephone Company's annual report will show 85,110 residence telephones out of a total of 179,366, being 35,302 increase. The new franchise required extensive alterations and plant additions. The total miles of telephone wire in the city are 442,081, being 85,336 increase. The total payroll is 7,254 people. In adjoining territory there are 50,000 telephones operated by 110 exchanges. The total toll line system is 22,500 miles of wire, much being under ground. Communication has been established everywhere east and west to Denver.

ELECTRIC RAILWAYS.

(Special Correspondence.)

WINSTON, N. C.—Dr. H. P. McKnight is interested in the formation of a company to build an electric line to Stuart, Va. L.

MERIDEN, CONN.—Attorney C. J. Danaher will petition the incoming Legislature for a charter to build a trolley road to West Peak.

DUBUQUE, IOWA—Business men of Dubuque will subscribe up to $6,500 for the expenses of a survey of an interurban road into Wisconsin. C.

ATLANTA, GA.—Surveys have been made for a seventeen-mile electric line to Union City. W. T. Roberts is president of the company and J. H. Longino is treasurer. L.

ELKHART, IND.—Maps and profiles have been made for the extension of the Bucklen electric road east from Angola to Montpelier, Ind., and west from Middlebury to Elkhart.

JERSEY CITY, N. J.—At a special meeting of the stockholders of the Railways Company General, held in Jersey City, the capital stock of the company was reduced from $700,000 to $500,000.

MUSKOGEE, OKLA.—The survey is reported completed for the Shawnee Central Railway from Shawnee to Muskogee, about ninety miles, and a survey is soon to be made to locate a line from Shawnee to Lawton, Okla.

GRUNDY CENTER, IOWA—An election will be held at Grundy Center, January 20, to vote on granting franchises to the Iowa Construction Company for a street-railway, electric-light plant, gas and telegraph system. C.

PEORIA, ILL.—The Peoria & Galesburg Railway Company has been incorporated with a capital stock of $100,000 to build and operate a railway from Galesburg and Canton to Peoria. D. M. Mayer heads the incorporators.

WESTON, W. VA.—The County Court has granted a franchise to Dr. George I. Keener for the term of fifty years for the construction and operation of an electric railroad from Weston to Bendale. The road must be completed within a year.

PORTLAND, ORE.—F. M. Swift and David Loring, of the recently-organized Clackamas Southern Railroad, announce that the company will build a broad-gauge electric line between Oregon City and the Molalla Valley. Plans are being drawn. A.

ATLANTA, GA.—A charter has been granted to the Atlanta Railway and Electric Company, which plans to build and operate a trolley line between Fairburn and College Park, where connection will be made with the interurban cars of the Georgia Railway and Electric Company.

GREENVILLE, PA.—The Mercer County Trolley Company, composed of James M. Campbell, L. W. Orr and Frank P. Filer, of Mercer, and S. D. Downs, of Greenville, successors of the McCain Construction Company, will make application for a charter. The line will connect Greenville, Mercer and Sharon.

SPOKANE, WASH.—Three million dollars will be invested by the Big Bend Transit Company of Spokane in the construction of an electric railway from Spokane, forty miles into the Big Bend wheat belt, going west as far as Miles, where the Spokane River joins the Columbia River. Work will be begun in the spring, it is said.

SPOKANE, WASH.—The Spokane & Inland Empire Railroad Company now operates 225 miles of standard electrical railway, connecting Spokane with Colfax, Moscow and Cœur d'Alene. The company's service of thirty-six trains a day is controlled by both telephone and telegraph despatching. A prompt freight service is maintained and all cars carry express packages.

MEXICO CITY, MEXICO—The Canadians who own the electric street railway and electric power systems are negotiating for the purchase of the Chihuahua and Pacific Railroad, which is owned by Gov. Enrique C. Creel. Dr. F. S. Pearson, president of the Mexico Tramways Company, is conducting the negotiations on behalf of the Canadian syndicate. Several million dollars is involved.

KENOSHA, WIS.—Albert C. Frost, the builder of the Chicago & Milwaukee Electric Railway, has disposed of one of the lines of the Kenosha Electric Railway Company to the Investment Registry Company, of London, England. The consideration for the property is given out at $300,000. The line has been a paying investment since its construction by B. J. Arnold, of Chicago, six years ago.

TOLEDO, OHIO—According to W. J. Sherman, of the engineering firm of Riggs & Sherman, Toledo, preparations are being made on an extensive scale for electric-railway work in 1909. Indications are that while operations may not be so active as at some former times, electric-railroad building will be far more active than it has been during the year just closed. This firm is working out the details of a number of large undertakings. H.

NEW YORK, N. Y.—On Monday, December 21, the Interborough lines carried an excess of 1,800,000 passengers, which is the biggest day in its history. This total includes those carried in the subway and elevated lines. Of this number about 861,000 were carried in the subway, or about forty-five per cent. The subway is doing thirty per cent more business than last year, while the elevated lines are doing three per cent less.

BLUFFTON, IND.—The Bluffton, Berne and Celina Traction Company has incorporated with $50,000 capital stock. The object of the company is to build, equip and operate an interurban road between Bluffton and Celina. The road will be forty-seven miles in length, and will connect a number of towns which are without railroads at present. The company proposes, also, to generate and distribute electricity for light, heat and power. S.

NEW YORK—Judge Ray of the United States Circuit Court has overruled the demurrer interposed by the defendants in the suit brought by the Continental Securities Company of New Jersey in behalf of itself and other stockholders against the Interborough Rapid Transit Company, the Metropolitan Street Railway Company and the Metropolitan Securities Company. The suit alleged that the merger created was a monopoly in violation of the law.

CHICAGO, ILL.—Chicago is to have another electric railroad line to Milwaukee, it is reported. The Chicago, Kenosha & Milwaukee Electric Railway Company will build it. Chicago and Evanston capitalists are financing the road. A right-of-way, 100 feet wide, already has been purchased between Waukegan and Kenosha at a cost of $250,000. Construction work on this portion of the road will begin soon. George G. Wilcox is president and Volney Foster, Jr., of Evanston, vice-president of the new road.

BROOKLYN, N. Y.—The contract between the Brooklyn Rapid Transit Company and the American Express Company, by which express matter was handled by trolley cars, expired on December 31 and will not be renewed, for the present at least, because the companies cannot come to terms. Wagon service has been restored by the express company. The trolley-express service has been found a great convenience and time-saving feature by the public. Besides taking in the suburbs of Brooklyn the service extended to Jamaica, Flushing, College Point and other adjoining places.

SPRINGFIELD, MASS.—The recent decree of the Supreme Court of Massachusetts, directing the New York, New Haven & Hartford Railroad to relinquish its interests in sixteen trolley lines in the state, was complied with on December 29 at a meeting of the New England Investment and Securities Company, when two of the trustees, who are also directors in the New Haven Company, resigned. The trustees who retired were Nathaniel Thayer, of Boston, and William Skinner, of Holyoke. A. Willard Damon, of Springfield, and Henry L. Higginson, of Boston, were elected to succeed them.

TOLEDO, O.—The Ohio & Michigan Southern Railroad Company has been incorporated with $1,000,000 stock under the laws of Michigan. The new company takes over the property of the Toledo, Ann Arbor & Detroit Railway, a partially constructed electric line between Toledo and Ann Arbor. The officials of the new company are: President, Andrew E. Lee; vice-president, De Courcy F. Niles; secretary, treasurer and general manager, William E. Niles; superintendent of construction, Curtis W. Steudel; general counsel, John O. Zabel. The members of the board of directors are: Ex-Governor A. E. Lee, Vermillion, S. D.; William E. Niles, Sioux Falls, S. D.; John O. Zabel, Toledo; De Courcy F. Niles, Duluth, Minn., and N. A. Rees, Chicago, Ill. The road will be equipped for both freight and passenger traffic. Gangs of men are already at work on construction and the road will be completed with all haste. Headquarters have been opened in Toledo. H.

EDUCATIONAL.

EVENING COURSES AT LEWIS INSTITUTE, CHICAGO—The evening courses of instruction which began at Lewis Institute, Chicago, January 4, include a well-arranged course in electrical engineering, administered four evenings each week. The subjects treated during the four years of the course are divided as follows: First year, engineering principles of electricity; second year, direct-current motor and generator testing; third year, alternating-current transformers and transmission; fourth year, alternating currents by Steinmetz's method. Students may enroll at any time. The tuition for twenty evenings is five dollars.

NEW MANUFACTURING COMPANIES.

ELMIRA, N. Y.—The Benton Insulating Company, of Elmira, has been chartered with a capital of $50,000 to manufacture electrical apparatus. The incorporators are C. F. Riddle, E. J. Baldwin, T. Allison, Lena Austin and Jerome S. Wheeler.

PORTLAND, ORE.—The Western Manufacturing and Development Company has been incorporated with a capital stock of $1,000,000, by W. M. Saunders, W. G. Saunders, Leroy Lomax and others, to engage in the manufacture of waterwheels. A.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

AINSLEY, NEB.—The Box Elder Telephone Company has been incorporated with a capital stock of $25,000. P.

VOLIN, S. D.—The Volin Telephone Exchange Company has been incorporated with a capital stock of $25,000. P.

DEL RIO, TEX.—The Del Rio & Western Telephone Company has increased its capital stock from $20,000 to $60,000. K.

LEBANON, MO.—The LaClede County Telephone Company has been incorporated with a capital stock of $10,000. P.

DES MOINES, IOWA—Mississippi Valley Telephone Company has increased its capital stock from $200,000 to $300,000.

BAKER, WASH.—The Skagit River Telephone and Telegraph Company has been incorporated with a capital of $10,000. K.

BOONVILLE, ARK.—The Boonville Light and Water Company has been incorporated with a capital stock of $50,000. K.

HAYTI, S. D.—The Hamlin County Farmers' Telephone Company has been incorporated with a capital stock of $25,000. P.

GREAT FALLS, MONT.—Telephone connections between Ulm and Great Falls have been secured by Herbert Strain, of Great Falls. C.

ADVANCE, MO.—The Advance Telephone Company has been incorporated with a capital of $12,000, by J. H. Schonhoff and others. P.

SHEFFIELD, PA.—The Sheffield Telephone Company, of Warren County, just incorporated, gives its capital stock as $15,000.

ARTHUR, OHIO—The Arthur Mutual Telephone Company, of Arthur, Paulding County, has been formed by Claude Morris and others.

TABOR, IOWA—James T. Ward has been elected secretary and manager of the Mills County Telephone Company, at Tabor, to succeed S. B. Barnes. C.

SUPERIOR, WIS.—The Douglas County Telephone Company, at Superior, has been sold to the Wisconsin Telephone Company, with which it has been allied. C.

KEOKUK, IOWA—The Mississippi Valley Telephone Company, of Keokuk, has increased its capital stock to $300,000, of which $100,000 is to be preferred stock. C.

MONTGOMERY, ALA.—The St. Clair County Telephone Company of Pell City, Ala., has been chartered with capital stock of $10,000 by L. Cooke and others of the name.

LYNDON, N. Y.—The farmer citizens of Lyndon, a township in Cattaraugus County, which has within its borders no railroad, no telegraph or telephone line and no postoffice, are now moving for a telephone system.

TONOPAH, NEV.—The Postal Telegraph Company has concluded an agreement with the Southern Nevada Telephone and Telegraph Company by which the former will use the lines of the latter in southern and central Nevada. A.

BERKELEY, CAL.—Manager F. E. White, of the Pacific States Telephone and Telegraph Company at Berkeley, announces that the company will, within the next year, lay more than 100,000 feet of cable in Berkeley at a cost of upward of $100,000. A.

PAXTON, IND.—The Paxton Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $5,000. The company will build, equip and operate a telephone system in Paxton and throughout Sullivan County. Jacob Cox is president and Alva McCannon is secretary. S.

ALBANY, N. Y.—The Federal Telephone and Telegraph Company, capital $6,000,000, with principal offices in Buffalo, has filed a certificate of incorporation. The company proposes to operate telephone and telegraph lines in the principal cities, towns and villages in the state. The directors are: E. G. Hubbell, W. H. Andrews, C. C. Machemer, R. W. Chapin, G. A. Plimton, H. H. Little, R. R. Hefferd, Andrew Langdon, T. B. Lockwood, C. W. Goodyear, A. D. Bissell, C. L. Ingham, W. P. Cooke, Buffalo, and G. D. Morgan, Rochester.

WINNIPEG, MAN.—The careful administration of the affairs of the system of telephones since the government of Manitoba took over the Bell Telephone Company business, is in evidence by the fact that a substantial reduction in rates took place with the opening of the new year. Residential phones under the Bell control costing $30 per year were reduced to $20. Business phones formerly $50 saw a reduction of from $15 to $20 per year. Wherever possible throughout the province the rates will be lowered, as the showing already made by the telephone commissioners in the first year of government ownership has demonstrated that the system can be made self-supporting by this reduction.

SAN FRANCISCO, CAL.—Joseph Harris, of the Automatic Electric Company, of Chicago, which is furnishing apparatus for the Home Telephone Company, of San Francisco, is in San Francisco to remain for several months directing the installation of the Home Telephone Company's system. He announces that 15,000 telephones, together with switchboards and other appliances, are on the way from Chicago for the telephone company, and that 50,000 more telephones will be shipped as soon as the installation of the first 15,000 is well under way. Mr. Harris also states that the Home telephone companies on the Coast will connect the cities of Los Angeles, San Francisco, Portland and Seattle with long-distance lines as soon as the local systems are in working order. A.

KINGSBRIDGE, ENG.—On December 11 a new wireless telegraphy station was opened at Bolt Head, near Kingsbridge, South Devon, England. The station is about fifteen miles southeast of Plymouth. Bolt Head stands 350 feet above the sea level, which is considerably higher than the Marconi station in Cornwall. The work was begun about seven months ago, an eight-horsepower oil engine with dynamo and all the necessary electrical appliances having been installed. The radio-telegraphic instruments are a combination of the Marconi system and patents owned by the government postoffice. If the experiment is found satisfactory it is anticipated that the government will provide other stations. It was expected to have the new station ready for public messages during the first week in January.

INDUSTRIAL ITEMS.

THE TRIUMPH ELECTRIC COMPANY, manufacturer of electrical machinery, Cincinnati, Ohio, is distributing a timely and useful gift in an attractive calendar, with a handsome art subject.

THE PETTINGELL-ANDREWS COMPANY, maker of lighting fixtures, Boston, has enclosed to those likely to be interested a novel little portfolio of handsome designs in electrical fixtures and decorative outlets.

THE AMERICAN CARBON AND BATTERY COMPANY, East St. Louis, Ill., is sending to its friends a clever calendar card, calling attention to the excellent qualities of American self-lubricating carbon brushes.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., is distributing a bulletin devoted to a description, with illustrations of its silico-vanadium steel transformers. An attractive calendar for January is also being distributed.

THE TRUMBULL ELECTRIC COMPANY, Plainville, Conn., maintains the motto of its monthly publication *Trumbull Cheer* in its "fond desire to be cheerful" in the January issue. Several pages are devoted to such Trumbull specialties as decorative receptacles, extended-handle switches and panel parts.

THE COMMERCIAL TESTING AND ENGINEERING COMPANY, Old Colony Building, Chicago, announces the opening of offices and laboratories, specializing along the following lines: Boiler room economies, coal analysis, heat value method of purchasing fuel, coal washing and preparation for operators. Edward H. Taylor is president of the company.

THE STONE & WEBSTER CORPORATION has been appointed to straighten out the entanglement of the Interborough-Metropolitan Street Railway System in New York city. The Stone & Webster Corporation is composed of Charles A. Stone, Edwin S. Webster and Russell Robb, all graduates of the 1888 class of the Massachusetts Institute of Technology, and Henry G. Bradlee of the class of 1891.

THE WESTERN ELECTRIC COMPANY, Chicago, whose engineers have devoted attention to the electrical equipment of various plants, now issues bulletin No. 5910-10 on electrical equipment for textile mills in which matters of drive illumination and communication between departments are considered in detail. The pamphlet is illustrated with a number of views of existing installations using Western Electric generating machinery, motors and lamps.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., and Chicago, Ill., has issued two bulletins relating to its direct-current dynamo-electric machines. The Holtzer-Cabot type M generator is especially designed for plating service and furnishes 700 amperes at six volts. Other new features listed in recent publications of the company are its new type A flush wall telephone for handsome interior installations, and its magneto watchman's register clock.

THE NATIONAL ELECTRIC LAMP ASSOCIATION, Cleveland, Ohio, through its engineering department, has prepared a bulletin of miniature carbon-filament incandescent lamps for decorative, battery inspection, automobile, telephone and special service purposes. Each lamp described is accompanied by complete engineering data, giving candlepower, voltage, watts, watts per candle, current consumption, style of filament, bulb dimensions, directional candlepower and useful life.

THE RAYMOND CONCRETE PILE COMPANY, of New York and Chicago, has recently established two new branch offices, one at 204 Perrin Building, New Orleans, La., and the

other at 620 Chestnut Street, St. Louis, Mo. The New Orleans office for the territory of the Southern States is in charge of Mr. G. B. Raymond, a son of the late A. A. Raymond, inventor of the pile that bears his name. The St. Louis office is in charge of Mr. Warren A. Tyrell, C. E., who has represented the Raymond company in that city for some time.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4620 describes its series luminous-arc rectifier system, which forms a striking contrast to the old open-arc system of lighting. The bulletin illustrates the various pieces of apparatus used in connection with the system, including arc-lamp hangers and cut-outs, constant-current transformers, mercury-arc rectifier tubes and switches, and contains, also, dimensions and connection diagrams. In bulletin No. 4631 is similarly described the company's series alternating enclosed-arc-light system.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a new bulletin describing Hartman type autotransformers and circuit-breakers for use with polyphase induction motors. These starters are primarily designed for use in mills and factories, and by means of overload, underload and low-voltage coils secure the maximum degree of protection. The Central Electric Company is also issuing a comprehensive circular descriptive of "Opalux" shades and reflectors. A number of photometric tests have been made by the Electrical Testing Laboratories of New York city, from which curves are reproduced in the circular. Copies of these bulletins will be sent upon request.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the second issue of each monta.)

ALABAMA LIGHTING AND TRACTION ASSOCIATION. Temporary secretary, F. K. Jackson, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, Walker Electric Company, Twenty-third and Noble streets, Philadelphia, Pa. Next meeting, January, 1909.

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AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa.

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ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, San Francisco, Cal. Monthly meetings, San Francisco, Cal., first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York, N. Y. Board of directors meets second Friday of each month.

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MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

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MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MILWAUKEE SOCIETY OF ENGINEERS. Secretary, W. Fay Martin, 456 Broadway, Milwaukee, Wis.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-treasurer, Ludwig Kemper, Albert Lea, Minn. Second annual meeting, Nicollet Hotel, Minneapolis, Minn., March 18-19.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

MUNICIPAL LIGHTING ASSOCIATION OF MASSACHUSETTS. Secretary, J. C. Norcross, Hudson, Mass.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State Street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Temporary secretary, J. D. Crary, Aberdeen, Wash.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. M. Kimball, Kenosha, Wis. Annual meeting, Milwaukee, Wis., January 20-21, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Scherrer, New York, N. Y.

ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, C. B. Roulet, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. S. Smith, Towanda, Pa.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Next annual meeting, Louisville, Ky., October 12-14, 1909.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler, Jr., 608 Juanita Building, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. A. Gould, Ennis, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio Street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

American Association of Electric Motor Manufacturers. Next meeting, January, 1909.

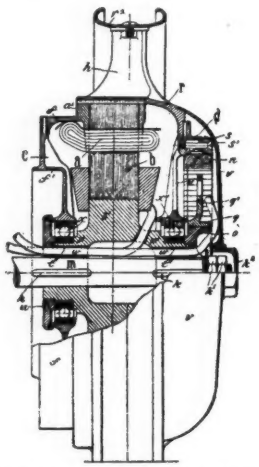
Minnesota Electrical Association. Second annual meeting, Nicollet Hotel, Minneapolis, Minn., March 18-19.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 29, 1908.

907,711. AUTOMATIC SPEED-CHANGING GEAR. James S. Anthony, New York, N. Y., assignor to General Electric Company. Filed April 28, 1906. An automobile has electromagnetic clutches whose circuits are controlled by automatic means responsive to variations in the speed of the driving wheels.

907,712. PROTECTED HIGH-POTENTIAL RAIL. Albert H. Armstrong, Schenectady, N. Y., assignor to General Electric Company. Filed July 21, 1906. An inverted third rail has a protective covering connected through a resistance to the main rail.



907,715.—AUTOMOBILE WHEEL WITH MOTOR ENCLOSED.

907,714. ELECTROMAGNETIC RELAY. Garrison Babcock, Rochester, N. Y., assignor to Merton E. Lewis, Rochester, N. Y. Filed May 31, 1906. Between two bell-crank levers connected to the magnet core is a mercury bulb containing contacts that are connected when the bulb tilts.

907,715. DRIVING-WHEEL FOR ELECTRICALLY-PROPELLED VEHICLES. Dmitry Balachowsky, Paris, and Philippe Caire, Levallois-Paris, France. Filed May 8, 1907. A motor-driven wheel comprises a fixed field magnet having a lateral extension, a rotary armature, a commutator frame connected therewith and having a central hub rotatable on the extension.

907,717. CHOKE-COIL FOR MOVING-PICTURE MACHINES. Harry J. Beck, Philipsburg, Pa. Filed July 30, 1908. Details of construction for a choke coil for the arc circuit of the projecting lamp.

907,725. REGULATOR FOR TANGENTIAL WATERWHEELS. James M. Boyle and Frank W. Roller, New York, N. Y. Filed April 1, 1908. An electrically-actuated mechanism for varying the cross-sectional area of the jet.

907,726. TROLLEY-WHEEL. Claude M. Bradfield, Grand Rapids, Mich. Filed March 28, 1908. Has a pair of inner bearing members arranged in the arms of the harp and a pair of conical outer bearing members.

907,738. POLEPIECE FOR DYNAMO-ELECTRIC MACHINES. Alexander Churchward, Chicago, Ill., assignor to General Electric Company. Filed August 23, 1901. A laminated polepiece has a middle portion of alternate laminæ cut away to increase the magnetic reluctance at the middle of the poleface, the other laminæ being solid.

907,740. SWITCHBOX. Arba G. Clark, Schenectady, N. Y., assignor to General Electric Company. Filed April 18, 1908. A switchbox for use with track switches comprises a shaft, contacts carried thereon, but insulated therefrom, stationary contacts adapted to be engaged thereby, and a link of variable effective length.

907,751. TESTING SYSTEM FOR TELEPHONE LINES. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed June 29, 1903. In combination with the cord circuits is a testing conductor in common with them, but normally disconnected therefrom.

907,752. ELECTRIC CONTROLLER. William S. Deeds, Pittsburg, Pa., assignor of one-half to James M. Graham, Pittsburg, Pa. Filed February 18, 1908. A motor with stationary electromagnets has circumferentially-arranged extensions in circuit therewith and spring-pressed couplers arranged in a collar around the extensions for bridging them.

907,754. ATTACHMENT FOR LINOTYPE MACHINES. Oscar H. Desmarais, New York, N. Y. Filed August 24, 1908. A guided plate adapted to co-operate with the galley, so as to close and open the same to access, is controlled by a rotatable electric switch.

907,763. CONTROLLER-CHECKING DEVICE FOR STREET-RAILWAY CARS. Nathan Fallek, Denver, Colo. Filed September 9, 1907. The armature of an electromagnet is arranged to lock a pawl and ratchet so as to check the controller handle.

907,770. ELECTRIC-LIGHT SWITCH. Walter W. Fulton, Chicago, Ill. Filed September 23, 1907. A spring clip has arms adapted to embrace the flattened T-head of a switch key, a crank arm being carried by the clip and a pendent cord carried by the crank arm.

907,782. INCANDESCENT-ELECTRIC LAMP SOCKET. Gilbert W. Goodridge, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Filed July 31, 1907. Has a cap with corrugated flange and projections thereon and a shell with corrugated ends.

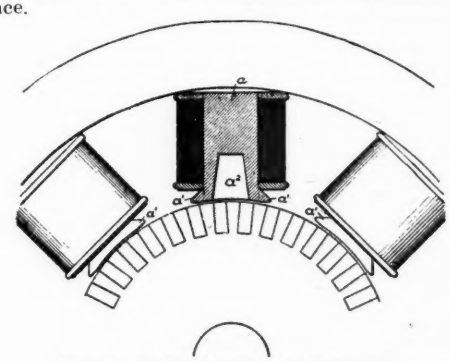
907,788. INSULATOR CLIP. Alphonso R. Hall, Leonardsville, N. Y., assignor of one-half to Lynn C. Maxson, West Edmeston, N. Y. Filed October 21, 1908. A stirrup of U-form has each end formed to provide an acute angle where to seat the line wire.

907,804. TOLL TELEPHONE SYSTEM. David S. Hulfish, Chicago, Ill., assignor to Baird Manufacturing Company, Chicago, Ill. Filed March 28, 1903. Toll apparatus includes a coin-refunding means operable by the depositor, these means being secured against operation by a relay in the circuit for speech transmission.

907,806. STATION INDICATOR. George Ipson, Huntington, Utah. Filed May 28, 1908. Every time the conductor advances the rolls on which the web is wound, an electric bell is rung automatically.

907,822. SYSTEM OF VEHICLE SUSPENSION. Carl W. Larson, Schenectady, N. Y., assignor to General Electric Company. Filed August 24, 1907. The patent relates to the mounting of an electric mining locomotive.

907,831. RESISTANCE-ADJUSTING DEVICE. Hector P. MacLagan, Chicago, Ill., assignor to National Rheostat Company, Chicago, Ill. Filed April 24, 1907. An electromagnet is adapted to hold a contact lever to a circularly-arranged resistance.



907,738.—LAMINATED FOLE-PIECE.

907,834. INSULATOR. George B. Marshall, Shannon, Tex. Filed October 9, 1908. The insulator comprises a spike with a clip formed on one side having a concave face adapted to grasp an insulator structure.

907,852. BATTERY CONNECTOR. Harry W. Munyan, Worcester, Mass. Filed February 21, 1907. Comprises a continuous conductor having integral resilient coiled terminals, forming compressible springs at the ends thereof.

907,866. LIGHTNING ARRESTER. Albert Oleson, Toledo, Ohio. Filed August 1, 1906. The rupturing of fuses mounted on a rotatable spool enables the discharge to pass to ground.

907,872. OIL OR THERMAL CUT-OUT. Charles N. Pratt, Rochester, N. Y. Filed June 6, 1907. An oil receptacle is provided with means for making and breaking a circuit under the liquid when the lid is actuated.

907,884. MOTOR COMPRESSOR. Walter J. Richards, Milwaukee, Wis., assignor to National Brake and Electric Company, Milwaukee, Wis. Filed November 4, 1907. The motor frame and cylinders are all cast to form an integral structure.

907,891. COMMUTATING DYNAMO-ELECTRIC MACHINE. Karl Sulzberger, Charlottenburg, Germany, assignor to General Electric Company. Filed January 16, 1906. The machine is provided with commutating poles slotted in axial planes, the slots being dissymmetrical with respect to the plane through the middle of the pole.

907,894. MEASURING INSTRUMENT. Edward Schildhauer, Washington, D. C. Filed December 3, 1906. An electromagnet is associated with a pad frame so as to cause movement thereof to receive an impression indicative of the instrument reading.

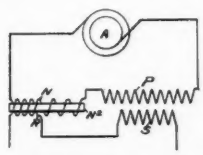
907,899. TROLLEY-GUARD AND REPLACER. Jesse J. Schultz and William C. Taggart, Richmond, Ind. Filed May 25, 1908. A pair of oppositely-disposed prongs are caused to extend along the sides of the trolley wheel projecting rearwardly and flaring apart.

907,911. APPLIANCE FOR CONDUIT WIRING. James S. Stewart, New York, N. Y., assignor to Annie Stewart, New York, N. Y. Filed November 13, 1907. Details of an outlet box.

907,929. ELECTRIC IGNITING SYSTEM. Edward Q. Williams, Syracuse, N. Y. Filed August 24, 1906. A jump-spark coil has a switch in its secondary circuit, movable into and out of contact with either of the terminals.

907,931. APPARATUS FOR REGULATING THE VOLTAGE OF AN ELECTRIC CURRENT. Wynant J. Williams, Albany, N. Y. Filed March 12, 1908. Consists of a transformer, a core which is normally saturated at all loads, a primary coil wound on this core and connected in series with the primary of the transformer, and a secondary coil on the core in series with the secondary of the transformer.

907,960. TELEPHONE ATTACHMENT. Gerrit J. Boelen, The Hague, Netherlands. Filed June 3, 1908. A combined telephone and talking machine is controlled by the signal circuit of the former whereby its sound circuit is closed and the talking machine started.



907,931.—VOLTAGE REGULATOR.

907,969. FLASH LAMP. Ellery S. Caywood, Chicago, Ill. Filed October 28, 1907. From a dry battery as a holder run out two insulated conducting rods to a trough for holding the flash powder.

907,970. SEPARATOR FOR STORAGE BATTERIES. Rufus N. Chamberlain, Depew, N. Y., assignor to Gould Storage Battery Company, New York, N. Y. Filed May 11, 1905. Composed of sections of pervious hard rubber sheets held in a flexible framework.

907,975. TELEPHONE TRANSMITTER. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Filed February 23, 1906. A resilient diaphragm coated on the inner surface to form an electrode co-operates with granular carbon in a cup.

907,984. TROLLEY. Joseph Franklin, Philadelphia, Pa. Filed May 1, 1907. The trolley pole is formed of a number of telescopic members.

907,985. PUSH-BUTTON-CONTROLLED PLUNGER ELEVATOR SYSTEM. Floyd C. Furlow, Montclair, N. J., assignor to Otis Elevator Company, Jersey City, N. J. Filed April 25, 1906. An electric system operates the controlling apparatus of a hydraulic elevator.

907,986. COMBINED ELECTRIC BRAKE AND PUSH-BUTTON PLUNGER-ELEVATOR SYSTEM. Floyd C. Furlow, Montclair, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed January 8, 1907. A modification of the above in which an electric brake is also controlled.

908,031. TROLLEY SWITCH. Alexander Palmros, Fairmont, W. Va., assignor to the Jeffrey Manufacturing Company, Columbus, Ohio. Filed January 12, 1901. An electromagnet is arranged to shift a movable blade.

908,063. WHISTLE. Henry W. Aylward, New York, N. Y., assignor to the Signal and Control Company. Filed January 22, 1908. There are magnetically-operated means for actuating the pilot valve.

908,068. TROLLEY HARP. Thomas F. Brennan and Thomas J. Mullen, New York, N. Y. Filed June 4, 1908. Provides lubricating passages in the journal sleeves.

908,073. AUTOMATIC TIME SWITCH. George R. Clark, Dayton, Ohio. Filed October 29, 1906. A spring arm delivers a blow to projecting arms on opposite sides of the pivotal point of the switch.

908,089. INSULATOR. James C. Gibson, Owensboro, Ky., assignor of one-half to A. H. Smith, Owensboro, Ky. Filed May 9, 1908. The cross-arm carries a threaded stud upon which the convex under side of the insulator is screwed down.

908,097. MAGNETO ALTERNATING-CURRENT GENERATOR. Adolf Herz, Vienna, Austria-Hungary. Filed February 13, 1905. A multipolar rotary permanent magnet has means to prevent its demagnetization.

908,098. WINDING FOR ROTATING FIELDS. Hjalmar Hertz, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed January 2, 1906. The winding consists of two sets of convolutions which begin with the innermost end connections and proceed outwardly, terminating at opposite ends of the rotor.

908,105. INDICATOR FOR TRAFFIC CARS. Albert C. Killius and Washington McCormick, Hillyard, Wash. Filed October 8, 1907. An electric actuating means for each drum for winding up the web.

908,117. LIGHT REGULATOR FOR ELECTRIC LAMPS. Thomas E. Murray, New York, N. Y. Filed February 11, 1907. A box contains a liquid dielectric, a rotary shaft with a radially-disposed contact plate, an independent contact bearing on the surface of the plate and buckets on the plate for projecting the dielectric on the bearing surface of the contact.

908,118. LOCKING DEVICE FOR FUSE PLUGS. Thomas E. Murray, New York, N. Y. Filed June 9, 1908. The fuse-plug body has a cylindrical threaded portion, a flange above this and a flaring cup-shaped portion with slots formed in its walls.

908,123. OIL SWITCH. Johan B. Opsahl, Chicago, Ill. Filed September 26, 1907. The switch is opened by admitting oil under pressure to a cylinder to raise the movable contact.

908,126. ART OR METHOD OF TREATING AND UTILIZING CHLORINE GAS. Edward C. Paramore, Philadelphia, Pa., assignor to Electro-Bleaching Gas Company, New York, N. Y. Filed February 5, 1907. The gas is washed and cooled, then suddenly heated and passed into a dielectric chamber and subjected to an electrifying action, the purified gas being finally refrigerated for the purpose of liquefying it.

908,130. METHOD OF PRODUCING SILICON. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Filed May 22, 1905. Silicon is produced in an electric furnace by first producing crude silicon containing silicon carbide and then in a second reaction oxidizing the carbon under fluid silicon.

908,135. ELECTRIC METER. William H. Pratt and Charles E. Holmes, Lynn, Mass., assignors to General Electric Company. Filed June 5, 1905. An integrating meter comprises a shaft carrying an armature and a damping plate, a circular permanent magnet with its poles adjacent to the plate and a series coil in inductive relation to the armature.

908,136. THIRD-RAIL INSULATOR. Leonard M. Randolph, Newark, N. J., assignor to Essex Company, Newark, N. J. Filed May 2, 1907. A two-part insulator for an under-running rail has flanges to support the rail and a hook-bolt holding the parts together and against the support.

908,166. ROSETTE. James S. Stewart, New York, N. Y., assignor to Annie Stewart, New York, N. Y. Filed December 23, 1907. An outlet box contains a body having terminal clips fastened to it at either side of a partition, and a cap fitting over this so as to grip the lamp cord.

908,167. ELECTRICAL DISTRIBUTION SYSTEM. Percy H. Thomas, Montclair, N. J., assignor to Cooper-Hewitt Electric Company, New York, N. Y. Original application filed November 8, 1904. Divided and this application filed June 8, 1905. Connected across variable potential bus-bars is a mercury-vapor tube in series with a resistance and a receiving circuit in shunt with the tube.

908,174. COMBINED FUSE-PLUG AND CIRCUIT CLOSER. Frederick F. Vindemore, Fairview, N. J. Filed March 7, 1908. There are means whereby the energizing of an electromagnet closes the circuit through the fuse.

908,180. THIRD RAIL. William J. Wilgus, Yonkers, and Frank J. Sprague, New York, N. Y. Filed May 27, 1905. An under-contact rail is loosely suspended from the brackets by holding blocks protecting the rail at the points of suspension.

908,189. RAILWAY SIGNAL. Harry M. Abernethy, Cleveland, Ohio, assignor to the American Railway Signal Company, Cleveland, Ohio. Filed March 24, 1906. An electric motor is operatively connected with means for rotating the semaphore.

908,213. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 4, 1902. A selective ringing system

for party lines includes aluminum cells to cut-out direct current from the ringing circuit.

908,238. AUTOMATIC ELECTRIC GAS-RANGE LIGHTER. Montgomery L. Ganser, Norristown, Pa. Filed August 12, 1907. The plug has terminal contact wires in it, which are connected together by a coiled sparking wire.

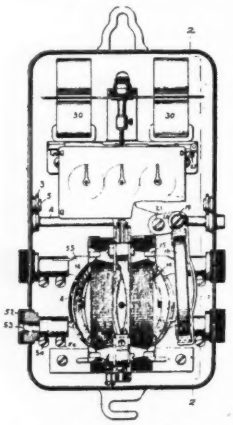
908,251. ELECTRIC CONTROLLING MEANS. Frederick G. Haldy, Stamford, Conn., assignor to the Yale & Towne Manufacturing Company, Stamford, Conn. Filed August 19, 1908. Includes means for reversing the motor circuit and placing the armature in series or parallel with the field and a supplemental resistance in series with the latter.

908,262. PORTABLE ELECTRIC LAMP. Jacob R. Hershey and Newton H. Smith, Keokuk, Iowa, assignors to Electric Service Supplies Company, Newark, N. J. Filed December 23, 1907. A hand lamp is provided with a socket-holding handle and a guard for the lamp.

908,300. COMBINED GAGE AND SIGNAL DEVICE. Mark G. Melvin, Scranton, Pa. Filed December 3, 1907. An electric alarm is actuated when the pressure is too high or too low.

908,307. SWITCH. Lembert H. Moulthrop, Bridgeport, Conn., assignor to the Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed September 12, 1908. An oscillating push-button switch.

908,323. ELECTRIC SWITCH. Johann G. Peterson, Hartford, Conn., assignor to the Arrow Electric Company, Hartford, Conn. Filed December 17, 1907. Has an insulating base with radially extending sockets in its upper face.



908,427.—WATT-HOUR METER.

908,340. RAILWAY SIGNAL. James A. Shingleton and Charles H. Roberts, Nashville, Tenn. Filed October 26, 1907. An electrical safety appliance is adapted to act on the throttle and brake levers of a locomotive.

908,357. METHOD OF PRODUCING SILICON CARBIDE. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Company, Niagara Falls, N. Y. Filed July 11, 1908. Consists in embedding a resistance conductor in a charge of silicious and carbonaceous material, initially heating the charge by combustion and then passing current through the conductor.

908,375. REGISTER AND DEVICE ASSOCIATED THEREWITH. Edward P. Baird, Evanston, Ill., assignor to Baird Manufacturing Company, Chicago, Ill. Filed July 11, 1902. A register for telephone service at the substation has an electrically-actuated responsive device at the central office whereby the reading of the subscriber's register may be received.

908,376. CALL REGISTER. Edward P. Baird, Evanston, Ill., assignor to Baird Manufacturing Company, Chicago, Ill. Original application filed July 11, 1902. Divided and this application filed July 31, 1908. A telephone call register has means under the control of the exchange operator for rendering the register inoperative by its advancing means.

908,379. SWITCHING DEVICE FOR ALL RAILWAYS. William F. Bath, Murray, Idaho. Filed September 19, 1905. An electrically-controlled track switch.

908,386. SAFETY PORTABLE MANUAL GENERATOR FOR IGNITING MINERS' SAFETY LAMPS. John C. Bowie and John H. Phelps, Cardiff, England, assignors to John Cunningham Bowie, Cardiff, England. Filed October 11, 1907. Consists of a magneto, an induction coil and a condenser.

908,389. ELECTRICAL CONNECTION. William H. Briggs, Richmond Hill, N. Y. Filed May 9, 1908. A battery connector has a terminal clip provided with a spring loop uniting opposed wings that are adapted to engage binding posts.

908,397. CONTROLLER FOR ELECTRIC CIRCUITS. Maxwell W. Day, Schenectady, N. Y., assignor to General Electric Company. Filed June 27, 1907. The generator has a fixed resistance in series with its fields and a variable resistance arranged to be connected in shunt either to the field or to the fixed resistance.

908,407. ELECTRIC FURNACE. Paul L. T. Héroult, La Praz, France, assignor to Société Electro Metallurgique Francaise, Froges, Isere, France. Filed October 3, 1907. The electrode for a furnace has a stuffing-box with a recess surrounding the electrode which is enlarged toward its outer end so that the withdrawal of the electrode tends to loosen the packing.

908,408. SYSTEM OF MOTOR CONTROL. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed August 23, 1907. There are means for cutting resistance into and out of the circuit as the voltage at the source exceeds or is less than a certain amount.

908,412. DEVICE FOR DETECTING INACCURATELY-FED SHEETS OF PAPER. Matthias M. Kandle, Longmeadow, Mass., assignor to Springfield Printing and Binding Company, Springfield, Mass. Filed January 10, 1908. An electromagnet is energized to effect the actuation of push-arms to engage and remove the sheet.

908,427. ELECTRIC METER. George E. Stevens, Lynn, Mass., assignor to General Electric Company. Filed June 8, 1905. A commutator-type meter has a friction-compensating coil adjustable in two different planes.

908,428. ELECTRICALLY-CONTROLLED SECONDARY CLOCK. Samuel P. Thrasher, Hartford, Conn., assignor to the Thrasher Clock Company, Manchester, Conn. Filed March 20, 1908. This clock is controlled by an electromagnet.

908,432. IGNITING DEVICE FOR MINERS' SAFETY LAMPS. Ferdinand A. Wicke, Barmen, and Rudolf Gartenmeister, Elberfeld, Germany. Filed July 8, 1908. A thin platinum wire heated by an electric current is adapted to ignite a priming composition for the wick.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired January 5, 1909:

466,357. ELECTRIC ANNUNCIATOR. C. Molitor, Chicago, Ill.

466,362. ELECTRIC RAILWAY CROSSING. Wm. Osner, Chicago, Ill.

466,368. SYSTEM OF ELECTRIC DISTRIBUTION FOR MOVING TRANSLATING DEVICES. N. W. Perry, Cincinnati, Ohio.

466,447. DEVICE FOR ELECTRIC ELEVATORS. R. C. Smith, Yonkers, N. Y.

466,448. COMMUTATOR BRUSH AND HOLDER FOR DYNAMO-ELECTRIC MACHINES AND MOTORS. F. J. Sprague, New York, N. Y.

466,471. UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS. C. P. Tatro, Spokane, Wash.

466,492. CABLE TELEGRAPHY. W. E. Facer, Cleveland, Ohio.

466,505. COMBINED ELECTRICAL PROTECTIVE AND TIME-DETECTING SYSTEM. J. S. Morse, New York, N. Y.

466,508. ELECTRIC SWITCH. G. E. Painter, Baltimore, Md.

466,509. ELECTRIC DROP LIGHT. G. E. Painter, Baltimore, Md.

466,510 and 466,511. ELECTRIC LAMP-SOCKET SWITCH. G. E. Painter, Baltimore, Md.

466,518. APPARATUS FOR SYNCHRONIZING CLOCKS. L. Von Orth, Berlin, Germany.

466,519. CIRCUIT CONTROLLER. H. P. White, Kalamazoo, Mich.

466,541. ELECTRIC RECIPROCATING TOOL. H. N. Marvin, Syracuse, N. Y.

466,604. ELECTRICAL SIGNAL BOX. T. F. Gaynor, Louisville, Ky.

466,620. MULTIPLE SIGNAL TRANSMITTER. C. E. Nash, Newton, Mass.

466,664. ELECTRIC BATTERY. P. B. Delany, South Orange, N. J.

466,686. ELECTRIC METER. C. K. Houguet, New Orleans, La.

466,702. MULTIPLE SWITCHBOARD BUSY-TEST CIRCUIT AND APPARATUS. F. A. Pickernell, Newark, N. J.

466,720. PROCESS OF OBTAINING INSOLUBLE CHLORIDES BY ELECTROLYSIS. S. C. C. Currie, Philadelphia, Pa.

466,760. REGULATION OF DYNAMO-ELECTRIC MACHINES. R. Thury, Geneva, Switzerland.

466,761. SAFETY FUSE FOR ELECTRIC CONDUCTORS. J. A. Wotton, Atlanta, Ga.